ELECTRICAL REVIEW

ILLUSTRATED.

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VIEWS, NEWS AND INTERVIEWS.

An annunciator company at Detroit has made a novel proposition to the directory of the World's Fair. It proposes to connect the cities of the two hemispheres by electricity, so that when President Harrison touches the electric button and starts the machinery, the fire bells will ring and the national flag will be hoisted in towns all over the United States, and the opening of the exposition announced to the cities of the old world.

Professor Barrett is in a quandary. Electricians are calling for more room than the World's Fair electricity building has. There are just 207,000 square feet of space to divide. Germany and England have each been assigned 20,000 square feet and France will use the same area. American firms have already applied for 200,000 square feet, and more applications are coming in daily. There will be no lack of exhibits in the branch of electricity.

The profits of the Frankfort electrical exhibition are reported as being $38,000.

A literary syndicate man was in Boston the other day and was surprised to find a cabdriver who reads Herbert Spencer. That cabman is a type here and ought not to surprise any one from New York or Philadelphia. If he had seen the electric car conductor who reads Dante in the original and discusses him with women of the New England Club on their way to their Dante class, he would have had an emotion worth while.—*Boston Transcript.*

The king of the Belgians did a very popular thing in opening the new glass banqueting hall at Laeken on Christmas eve. Instead of giving a court dinner he invited all the 500 workmen employed in the restoration of the palace to supper, and afterwards ordered them to be conducted through the whole of the Winter Garden, magnificently lighted for the first time by electricity. On leaving, each guest was presented with a bottle of wine, a case of sweetmeats and a purse of money.

The monitor "Miantonomoh," now lying at the Brooklyn navy yard, tested her new search lights last week.

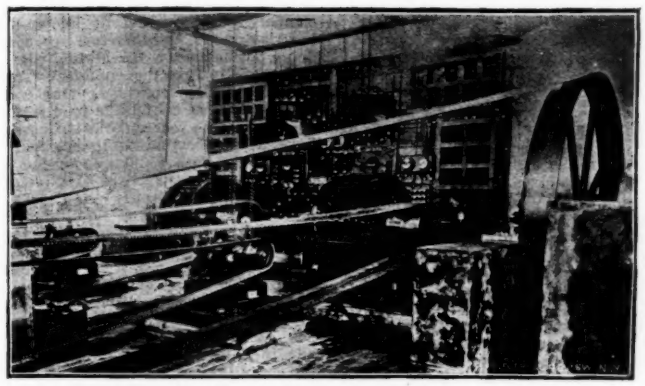
There was a great gathering of printers and publishers upon the invitation of the Typothetæ at the Hotel Brunswick, January 17, to celebrate the 186th anniversary of the birth of Benjamin Franklin. Theodore L. De Vinne presided, and Franklin, in confectionery, stood at his case on the table.

At the dinner of the Franklin Literary Society of Brooklyn, at the Clarendon hotel, on January 16, the patron genius of the society was credited with the invention of the trolley system of street railway transportation. Mayor Boody, a member of the society, came in and was called on for some remarks on "The City of Brooklyn." He said he had been called on before to speak upon a similar subject. In fact, he had so many opportunities to talk about Brooklyn that he had determined not to "do" the whole city in every speech, but to take it by wards. He admitted that Franklin was indirectly the inventor of the trolley system, and he only wished the old sage was here now to give his advice for the benefit of the city in the present trolley dilemma.

The Orange Athletic Club, of Orange, N. J., recently gave an amateur circus. Electric lights were used a-plenty, and the phonograph was exhibited. Mr. Edison was present at the circus.

Central Stations at Syracuse, Sicily, and Cuneo, Italy.

The station at Syracuse, Sicily, was erected by the Edison Company, of Milan, in 1889. The boilers were built at Glasgow. The engines are of the Armington & Sims type and were built in America. They are compound condensing engines of 80 horse-power each, and have a speed of 350 revolutions per minute. Each of the three alternating machines is driven by an engine connected by link belting. The alternators are of the Zipernowsky type and were furnished by Ganz & Company, of Buda-Pesth. Each generator has a capacity of 50,000 watts (25 amperes at 2,000 volts) at a speed of 500 revolutions per minute. The field and armature cores are cut out of one-half mm. sheet iron. The exciters are of the ordinary two-pole type, and have a capacity of 3,300 watts (30 amperes at 110 volts) at a normal speed of 900 revolutions per minute. The high tension switches are ebonite boxes filled with mercury and are raised and lowered to the contacts by lever. The potential of the alternators is regulated by an automatic rheostat acting on the shunt coils of the exciters. The alternators are run in parallel, and to switch the alternating machines into circuit a lamp battery is used. The conductors are carried on porcelain insulators, partly carried on poles and partly on house tops. The transformers used vary in size from three to ten horse-power, and the potential in the secondary is 115 volts.



CENTRAL STATION AT CUNEO, ITALY.

The central station at Cuneo, Italy, shown in the illustration, was built in 1888 by the Edison Company, of Milan. It receives its power from two turbines of 80 horse-power each, although steam engines have also been installed for reserve. There are two separate circuits, each of which is supplied by an alternating current machine of Ganz & Company, having a capacity of 50,000 watts (25 amperes at 2,000 volts) at 500 revolutions per minute. The transformers used average the same capacity as at Syracuse.

FRANK C. PERKINS.

The British Physical Society.

At a meeting of this Society on the 18th ult., Prof. W. E. Ayrton, F.R.S., president, being in the chair, a "Note on Interference with Alternating Currents" was communicated by Mr. M. H. Kilgour. Whilst studying Dr. Fleming's paper, on "Some Effects of Alternate Current Flow in Circuits Having Capacity and Self-Induction," the author constructed some additional curves. He was thereby led to investigate whether the serious rises of pressure produced by adding capacity would occur over considerable ranges of capacity, or whether they would only take place when the capacity was nearly equal to a particular value. Taking the case of a condenser of capacity C farads, in series with a current of resistance R ohms and inductance L henrys, he showed that the maximum value of λ (the ratio of the pressure across the condenser terminals to that across the condenser and inductive resistance) is obtained when $C = \frac{L}{R^2 + p^2 L^2}$ (1) where $p = 2\pi$ times the frequency; the maximum of λ produced by this capacity being given by the expression $\Lambda = \frac{\sqrt{R^2 + p^2 L^2}}{R}$ (2).

Taking R = 10 and $p = 2\pi$, 1,000 curves plotted from equations (1) and (2) between C and L and between Λ and L had been drawn. The CL curve rises to a very sharp peak at L = .0015, and falls rapidly. That between Λ and L starts horizontally and bends upwards, and approximates to an inclined straight line for values of L greater than 0.002; when L = 0.1, Λ = 63. Considering the question of the range of capacity with which a given rise of pressure can occur, it was pointed out that when the values of L, R and p are such as to make a large rise possible, a rise exceeding a moderate value can only be obtained for values of C differing little from that given by equation (1). On the other hand, when the circuit is such that the maximum rise possible is not large, then a rise exceeding a given moderate value can be obtained over a much wider range of capacity. Hence the author concluded that the larger the possible rise, the smaller is the probability of a serious rise occurring. The effect of shunting the condenser by a circuit of resistance r and inductance l was next dealt with in the paper, and the values of C which make λ a maximum determined, as well as the maximum value λ can have.

Subsequently, the author examined whether the practical case of an alternator feeding a transformer through a concentric cable may be simplified, without introducing serious error, by assuming the capacity concentrated at either end of the cable, and concluded that in ordinary cases little error will be thus made. In an experiment made with a 100 kilowatt alternator, ¾ mile of $\frac{4}{12}$ concentric cable, and an 18 kilowatt transformer, a rise of ¼ per cent. was found to occur at the terminals of the alternator when the cable was connected. Putting on the transformer unloaded or loaded produced little change in the rise of pressure; this in all cases being between 0.2 and 0.3 per cent.

After some discussion, the president said he understood the first object of Mr. Kilgour's paper was to inquire whether the dread of rise of voltage occurring when concentric mains were used, need exist. When Dr. Fleming's paper was read the general idea was that concentric cables were dangerous. In the discussion on it, he, amongst others, had pointed out that the chance of a large rise of pressure was not a serious one. Mr. Kilgour had now shown that the range of capacity over which a particular rise could occur is inversely proportional to the maximum rise possible in the particular circuit. When the circuit was such that a large rise was possible, the probability of any serious rise taking place was very small; hence the fears of large rises were more or less unfounded.

The second part of the paper was intended to show that ordinary problems on concentric cables could, in practice, be treated with sufficient accuracy, by assuming the capacity localized at either end of the cable, instead of distributed along its length.—*London Industries.*

Important Telegraph Decision.

On the 19th inst. the Canadian court of appeals gave its opinion of the contract which the telegraph companies have printed on the blanks which they furnish. The case in question was that of Laurence against the Great Northwestern Telegraph Company.

While Mr. Lionel Laurence was in New York one of his employes sent him a dispatch, saying: "Writing you to-night." The sentence was made to read: "Waiting you to-night." Consequently Mr. Laurence made an unnecessary trip to Montreal, and sued for $200 damages. The court in the first trial awarded $30, the actual cost of the trip. The company appealed and then set up the plea that whilst the case was one of negligence of their employés, yet the dispatch was sent under a contract which declared that it would not be liable for damages resulting from errors unless the dispatch was repeated, and then only to the amount of 50 times the price paid for the message. Such a contract the court declared to be contrary to public policy, and any contract by which a party sought to fix a punishment of his faults was illegal. The judgment was confirmed.

The annual meeting of the Edison General Electric Company, was set down for the 19th inst., but it was found necessary, under the new law, to postpone it to February 10, as a four weeks notice is now required.

The Probable Future of Condensers in Electric Lighting.

BY JAMES SWINBURNE.

It is always difficult to foretell the future in electrical engineering work, but it is sometimes interesting to try to see in what direction developments are likely to take place.

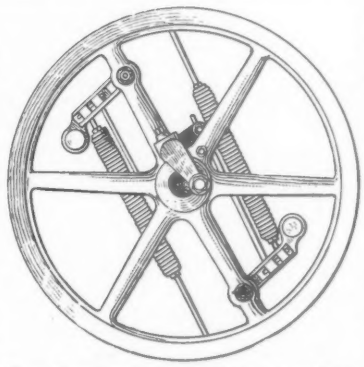
The first idea of the use of condensers was to employ them like storage batteries, and mention is frequently made by the early electric light patentees of their proposed use in this way. It is needless to remark that these inventors had not the most remote idea of the vast electrostatic capacities needed for storing by the hundred ampere hours.

The project of using condensers instead of transformers is by no means dead. It has been recently taken up on scientific principles by Mr. Doubrava. As soon as a condenser is charged and discharged rapidly enough its size becomes manageable, and Mr. Doubrava is therefore working out a system in which condensers take the place of converters. This development is in good hands, and need not be discussed farther. One great difficulty is in charging condensers with direct currents. A condenser of the capacity of a farad charged with one volt contains, if the expression be allowed, only half a joule. If a condenser is charged by being connected to leads at one volt, half a joule is wasted over resistance and the other half is stored. The only way of charging the condenser without loss is to connect it with an electromotive force which is gradually rising. Similarly, in discharging, the electromotive force must fall gradually. This condition is not at all difficult to attain.

The greatest development of the use of condensers will probably be in connection with alternating currents. It is doubtful whether ingenuity will ever design an arrangement of condensers that will take the place of transformers in practice. In one sense there is better material to work upon. A transformer is always inefficient on account of hysteresis. The loss by "soaking in" may be taken as analogous to the loss by hysteresis, but it is infinitely less in comparison. For instance, a condenser that takes 2,000 volts and 10 amperes has a loss which is too low to measure—that is to say, it is less than five or ten watts. This loss is proportioned to the size of the condenser, so that small sizes are just as efficient as large ones. In transformers this is not the case. A 100,000 watt transformer has a loss of somewhat less than 1,000 up to about 5,000 watts, according to the design, and if the 100,000 watts is made up of a number of small transformers the loss is greater.

The uses for condensers are already developing. In the first place, they can be used to supply magnetizing or exciting currents to all sorts of machinery and also to apparatus that takes lagging currents. It must be remembered that the magnetizing current in any receiving apparatus means a demagnetizing current in the generator. As an example that will soon be common, and is also striking, we may take that of running arc lamps off 100 volt circuits with choking coils in series with them. As far as the lamp is concerned, there is no better arrangement than running it off a 100 volt circuit, with a choking coil in series with it to reduce the terminal pressure to about 30 volts. If such a lamp takes 10 amperes, the apparent power taken is 1,000 watts, but the real power is probably less than 300 watts. The dynamos at the station have thus to supply large "idle" currents. These not only lead to armature heating, but also demand extra excitation. If many arc lamps are used, more dynamos become necessary, as no machine will stand three times their normal armature currents, even though they are out of step with the electromotive forces. Such currents, therefore, lessen the plant output, or, as it is often loosely called, the "plant efficiency." To overcome this trouble, all that is necessary is to place condensers in shunt to the choking coils and lamps, or in shunt to the high pressure leads. The last arrangement is best, as it admits of arranging the condensers at the central station. In addition to this, condensers for 2,000 or 1,000 volts are easier to make than those for 100 volts. Condensers for such low pressure cost too much in tinfoil, and are somewhat bulky, because the dielectric has to be made thick in proportion, to make certain of the absence of flaws. At present comparatively few arc lamps are run in this manner, but that is because nearly all the alternating current systems now in use have small transformers in houses and high pressure mains about the streets. This barbarous custom is rapidly going out of fashion. It has taken people a long time to realize that there is an appreciable waste of power in house transformers, and high efficiencies were always quoted, the losses in the copper alone being considered. The loss in iron is more generally understood now, and the sub-station system is coming into use. This involves automatic gear, and, though certainly an improvement on the old methods, is hardly likely to live long. The system of avoiding loss by automatic gear is bound to go as soon as makers alter their designs and make their transformers more efficient at light loads. The feeder system will then prevail. A high pressure feeder will then have a transformer at the other end feeding into a low pressure network. The transformer will have so little loss that it will not be worth while to switch it out of circuit during the day. Even if automatic gear is used, it is not necessary to employ a complicated system of switches. An automatic switch in the secondary, which is controlled by the current in the primary, is all that is required. On breaking the primary circuit at the station, the switch opens the secondary. On making the primary, the secondary makes itself. Whichever method comes into use, it is probable that arc lights will be run off 100 volt circuits with choking coils, and condensers will be required at the stations. Of course, there is no reason why arc lights should not be run off high pressure circuits by means of constant current transformers. This system has never come into use in this country, probably because the low cost is not generally appreciated.

It may be well to give some idea of the size of a condenser. One cubic foot of a condenser will take about 2,000 volts and five amperes, or 10,000 apparent watts. With higher pressure the volume necessary is slightly less, and with low pressures the size increases. Below about 500 volts the bulk increases rapidly, as the volume of tinfoil is greater. The cost, therefore, increases, too. It is possible to make condensers very much smaller than this; but while they are new it is best to allow a large factor of safety. Choking coils and constant current transformers for arc lamps are not the only things requiring exciting currents. Transformers, especially if made with open iron circuits, take "idle" currents, and this can be supplied in the same way. Nearly the whole of an open circuit exciting current can be supplied by condensers. There is always some left over, because the electromotive force never varies exactly harmonically. Even if it did, there is some loss in the iron, so the no load current cannot be reduced to nothing. In a closed circuit transformer the no load current is less to be in with, but the active component is much greater, so that it cannot be reduced so much by condensers. It can generally be halved.—*Industries.*



NEW GOVERNOR OF THE ERIE CITY IRON WORKS ENGINE.

Erie City Iron Works Engine Governor.

The Erie City Iron Works, Erie, Pa., received a patent on January 5 for a new engine governor which is shown in the illustration presented herewith. This governor will be applied to all the Erie City Iron Works engines, an example of which was recently illustrated in these columns. The claims in the recently granted governor patent are, briefly, these:

The use of a rocker arm extending through the hub of the pulley, set sufficiently to one side of the center line so as to increase the lead of the engine with the load.

The form of governor arms with the double slots, making the machine work very simple.

The use of a detachable weight plate to the end of the governor arms, in the same manner as scale weights are put on to the end of a scale balance, to give the proper number of revolutions.

Electric Mutual Insurance Company.

An extremely satisfactory arrangement has recently been entered into by the Electric Mutual Insurance Company, of Boston. It guarantees to the electrical industries fairness in the matter of rates and opens a channel for the electrical companies to place their insurance without difficulty in the strongest companies in the country. It will give them the benefit of a systematic inspection by competent inspectors, of whom Capt. Brophy will be one, and it establishes a bureau that will be in possession of complete statistics as to premiums, losses and expenses, so that there will be no difficulty at any time, in the electrical industries in knowing whether the rates charged them are fair or unfair. Several prominent electrical men will be asked to join an advisory committee to meet and confer with President Stephen E. Barton, as often as may be deemed desirable, to the end that the business may be conducted in a manner satisfactory and with mutual profit to both parties.

A circular letter explaining the whole matter has recently been sent to the policyholders of the company. The circular is as follows:

OFFICE OF ELECTRIC MUTUAL INSURANCE COMPANY,
BOSTON, MASS., January 7, 1892.

To the policyholders of the Electric Mutual Insurance Company:

The directors of this company have this day executed a contract whereby the entire liability under all of its outstanding policies is assumed by the Home Insurance Company, of New York city, and the Electric Mutual will forthwith cease issuing policies.

This action was taken because it was deemed to be for the best interests of the policyholders as well as of the electrical industries in general.

The year 1891 was one of the severest in fire losses ever known. Eighty-two fire insurance companies ceased doing business during the year, and 38 of them were Mutual companies. Twenty-three of the latter failed outright, many of them making miserable failures disclosing dishonesty and in several instances involving additional assessments upon their policyholders to pay incurred losses and expenses.

While nearly all of these Mutuals were what are designated in insurance circles as "Western Wildcat Mutuals," the difference between them and legitimately conducted companies is not generally known by the insuring public, and therefore any company doing business upon the Mutual plan must suffer greatly from the confidence forfeited by these failing concerns. Our company has felt this lost confidence to a serious degree during the year and our business would have suffered beyond endurance had it not been for the high reputation of the gentlemen composing our board of directors and endorsing the company.

Owing to an unusual number of fires in electrical property, we were losing the support of companies that had helped us to carry the large amount of insurance on many of our risks. West of the Mississippi river we were practically deprived of such support.

The laws of nearly all the States are such that an insurance company without a *paid up cash capital* of $200,000, or more, is denied a license to transact business, and if a representative of such unlicensed company is found soliciting insurance, he is subject to arrest and heavy fine. Furthermore, the policies of unlicensed companies are not infrequently declined by bondholding institutions and other collateral interests.

This aggregation of obstacles made a change of some sort imperative.

The raising of a large cash capital and the reorganization of the Electric Mutual on that basis was considered by the directors, but before action was taken negotiations were opened with the Home Insurance Company, resulting in the very liberal proposition contained in the letter hereto appended and signed by Mr. D. A. Heald, president of that company.

By the reinsurance effected to-day all losses under Electric Mutual policies are guaranteed by the "Home" with its $10,000,000 of assets, and the possibility of an assessment on the Mutual policies is thereby removed.

In accordance with the spirit of Mr. Heald's letter, the formation of a syndicate is in progress, six of the largest stock companies having joined the Home already. I am confident that enough more will shortly join to make an association that will carry the whole insurance on the largest of the electrical risks, and ensure the carrying out of the proposition for fair and equitable treatment in the matter of rates.

Under the new plan, the renewal of policies now in the Electric Mutual, and those placed through us with other companies, may be effected with the undersigned as agent for the syndicate companies, the policies to be made by the companies' agents residing where the property is located. By that arrangement the local agent becomes interested in the insurance and a friend of the electrical company. A system of inspection more complete than the Mutual has been able to maintain will be continued by the same corps of inspectors.

For the time being, the business will be conducted from the present office of the Electric Mutual, but in the near future it will doubtless be found advisable to locate the office in New York city, of which change due notice will be given.

The present status of the Electric Mutual will remain unchanged, until all of its policies have expired, and any endorsements, consents, or other required changes will be promptly made, as heretofore, by communicating with the Company and forwarding policies for the purpose of endorsement.

Yours respectfully,
STEPHEN E. BARTON,
President.

The following letter from the Home Insurance Company is sent with the circular:

HOME INSURANCE COMPANY,
No. 119 BROADWAY,
NEW YORK December 31, 1891.

The Electric Mutual Insurance Company, Boston, Mass.:

GENTLEMEN—Having had some conversation with Messrs. Hastings and Barton, of your board of directors, concerning a possible arrangement for reinsuring the policies of your company, and learning from them that your board would like in writing the outline of a proposition with that end in view, I beg to state that this company would be willing to undertake the formation of a syndicate for a reinsurance contract, assuming the liability under all of your policies, by the payment to it on your part of the *pro rata* unearned premium of said policies, on such terms and at such date as might hereafter be mutually agreed upon.

We would endeavor to form an association or syndicate composed of, say, ten or more of the leading fire insurance companies for the transaction of electric insurance throughout the country.

We would employ Mr. Barton to manage such an electric insurance department, renewing present insurance and taking new electrical risks at the tariff rates, subject to modifications for improvements in accordance with a schedule for rating, to be prepared by Mr. Barton and presented to the several tariff organizations, wherever located, for adoption, provided the schedule is not less than the existing minimum rates on such risks.

On the part of this syndicate, if formed, we would agree that if, at the end of a period (say two years) sufficient to allow a fair average of results, it is found that the existing rates yield an underwriting profit in excess of 10 per cent., to authorize a reduction in the rates; it being our desire, if we enter into the arrangement, to receive as premium only such rates as will yield us a fair interest and profit on the capital invested.

Yours respectfully,
(Signed) D. A. HEALD,
President.

In a Receiver's Hands.

At a meeting of the creditors of the Connecticut Motor Company, Plantsville, Conn., held on the 16th inst., it was unanimously voted that the appointment of a receiver be applied for and that Mr. Sherman Blakeslee be nominated.

Gauging Hardness of Wires by Electricity.

An ingenious method of testing the hardness of steel has been invented by a Swedish metallurgist. It is based upon the intensity of current necessary to fuse a wire of a standard size. By experiment the current required to fuse standard wires of different degrees of hardness can be determined and upon this basis the quality of any sample can be ascertained.

Magnetic Properties of Liquid Oxygen.

Professor Dewar has made a highly interesting communication to the Royal Society. He sought to determine what effect a temperature of — 180° C. would have upon the behavior of liquid oxygen in the magnetic field. Having previously ascertained that liquid oxygen does not moisten or adhere to rock crystal, and consequently maintains in contact with that substance a perfect spheroidal condition, he poured the liquified gas into a shallow saucer of rock crystal, and placed it between the poles of the Faraday electro-magnet. On the magnet being excited, the whole mass of liquid adhered to the poles until dissipated.

PRACTICAL NOTES ON THE REFLECTING GALVANOMETER AND ITS ACCESSORIES.

BY J. D. BISHOP.

XV.

CONDUCTIVITY TESTS.

In conductivity as in insulation tests, it is difficult, if not impossible, to get accurate results with short lengths, and the least length required for conductivity tests is 100 feet, although a thousand would be better. The shorter your length the greater the error arising from incorrect measurement, accidental indentation, stretching or twisting of the wire, either of which will change its diameter. For measuring either the percentage of conductivity or the mileage resistance of any wire, it is first of all essential to know the length of the piece under test. Suppose, for instance, a manufacturer sends in a reel of No. 18 copper wire, and you wish to know its resistance or reciprocally, its conductivity. Proceed as follows: Procure a stout pine board 18 inches by six feet in length, and one and a quarter to one and a half inches thick. It must be framed at the ends and made rigid by two or three runners at the back, and of well seasoned dry wood, well planed.

Draw two lines across the board six inches from each end, or five feet apart; just inside this line bore nine half-inch holes, three-quarter inch apart, at one end, and ten holes at the other, into which drive some neatly turned hard rubber plugs two inches long, leaving three-quarters of an inch standing above the board. At three-eighths of an inch from the end of the plug a shallow groove should be turned, into which the wire to be measured should fall.

Now provide two stout terminals or binding posts. These terminals should be provided with screw pins large enough to have a hole bored through them, big enough to admit any size wire whose conductivity you wish to obtain, and the pins should also be long enough to carry two thumb screws. The hole should be bored in the pin close down to the shoulder and the body of the lower thumb screw must be of the same diameter as the shoulder. These terminals may be fastened to the board by the usual screw and washer of ordinary terminals. One thumb screw is to hold the wire to be tested firmly. The upper thumb screw is for the bridge connections.

Fasten one of these terminals at the end of the board containing the nine pegs, somewhere in the position a tenth peg would have been. The other you must fasten exactly where it is required, and to do this you must first get an exact length of 100 feet.

This is a very difficult problem, but for all practical purposes a careful measurement of a hundred feet on a smooth flat floor with a standard steel tape will be near enough.

Care must, of course, be taken that the tape lies straight. Draw two pencil lines on the floor at each end of the hundred feet exactly, and also another mark at right angles there to; this may be done by the steel tape itself whilst in position. Now take some No. 18 copper wire and make a loop in one end, which pass over a nail driven into the floor about six inches outside one of the marks; carry it along the floor and cut it off at, say, 18 inches beyond the other mark. In this end make a loop large enough to pass the hand through and pull on the wire hard enough to sensibly stretch it, and so remove all bends and kinks. If stretched too much it will become too hard for subsequent convenient handling. See that it lies perfectly straight on the floor, and it can only be made to do so by suddenly lifting it at one end and letting a wave of motion run through its whole length just the same as a surveyor straightens out a field chain.

When perfectly straight keep it there whilst an assistant drives another nail in six inches outside the other line, round which take three or four turns of the straightened wire. Now, with a pen knife carefully scrape the wire from exactly over the pencil line backwards towards the nail at each end.

This will distinctly define the limits of your 100 feet. Carefully coil up your wire in coils not less than 18 inches diameter, and, cutting off the small loop, pass the end through the hole in the pin of the terminal on your board until the end of the scraped mark exactly coincides with the shoulder of it, and screw down the thumb nut tight and firmly upon it.

Pass the wire carefully along the board and around the first rubber pin, back over the first pin next the terminal return to the second and so on, until the whole length is used up.

When you get to the end of the hundred feet make a pencil mark on the board exactly where the scraped mark on that end of the wire begins, and there place the terminal outside the line so that the edge of its shoulder will exactly meet the lead pencil mark.

The position of this last terminal will, in all probability, be found somewhere between the two lines of pegs on account of the length of wire necessary to go round them.

Wherever it is, it is evident that from shoulder to shoulder of the terminal you will have a hundred feet more or less exact according to the care taken in measurement and placing the wire round the pegs.

When your terminal is in place you may remove the wire and the board is ready to receive just a hundred feet of any wire you wish to test without the necessity of measurement.

The board should be hung up vertically or fastened to the wall with its lower end about 18 inches from the ground when putting on the first measuring or any subsequent wire so as to avoid the sag which would occur in every five feet length if placed on a table horizontally.

In taking samples from reels of wire to be tested, it is better not to take them from the outer layer, which may have become indented or injured in transit, but to run off the outer layers of coils first. In putting the wire on the measuring board it is best to take hold of it near the terminal and let it slip through the fingers, steadily feeling all its length as you pass it round the pegs. If a kink or notch or other signs of damage appears that length should be rejected and a new one laid in its place.

The wire should be held tight enough to straighten out slight bends and irregularities, but not enough to stretch it.

After it is on the board its diameter should be measured in several places with a micrometer caliper to make sure that it comes up to its gauge.

All that now remains to be done is to connect it with your bridge set. The resistance of your leads from the bridge set to the board must be carefully measured and the result subtracted from the total resistance.

But this calculation may be dispensed with and better results obtained by the following method: Take a piece of wire twice the length required for your leads and cut it in two equal parts. Use one half for your leads and put the other half between the terminals, which are to be found on one of the arms in nearly every bridge set. This will balance your leads and save calculation.

The board above described has sometimes been replaced by a cylinder on which is cut a screw V thread, and the number of turns multiplied into the circumference of the cylinder taken as the length of the wire tested.

But this is not a good method for it is evident that the smaller the wire the deeper it will sink in the thread and the shorter will be its length.

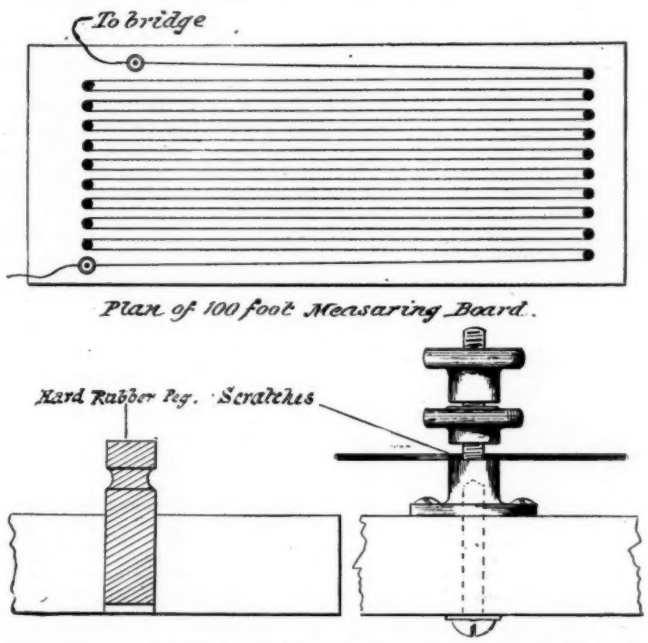
There are other considerations besides which render this method inferior to the flat board which will easily suggest themselves to the reader. Where, however, many specimens of the same gauge wire have to be measured, the cylinder offers the advantages of compactness and easy working, otherwise it is necessary to have a cylinder for each gauge of wire.

Another advantage of the board is that the air has free access to all sides of the wire, and the temperature will naturally be more uniform. In making comparative tests of various pieces of wire, care must be taken to secure the same temperature for each, and if the lengths are taken from a full reel or bobbin they should be allowed to remain on the board an hour or so before testing.

Most bridges have 10, 100 and 1,000 resistances in each arm, so that .01 ohm is the lowest subdivision which can be measured, but it is easy to obtain the third decimal, if necessary, by noting the number of divisions of the deflection marking the nearest approach to a balance attainable, and making that the proportionate part of the number of divisions deflection caused by plugging one ohm; but this refinement is useless unless your resistance coils and bridge are very first-class, because none of the coils are correct to .001 of an ohm. In ordinary practice .01 ohm is quite fine enough.

As the resistance of the circuit in these conductivity tests is very low, the insulation testing battery should not be used, or the coils may be warmed up by the current and make your results inaccurate. Besides this, the battery will tend to run down, and so, unless you are prepared for it, introduce an element of trouble. Sulphate of copper cells will be the best for this work, and from one to five will be sufficient.

In taking specific conductivity tests the above instructions, of course, apply with full force. All that will be required more will be a pair of fine assay scales for taking the exact weight of the lengths tested. But in ordinary practice specific conductivity tests are never called for, it being quite sufficient to know the actual resistance of the wire for comparison with another wire or with resistance found in the usual tables.



THE REFLECTING GALVANOMETER—PLAN OF ONE HUNDRED FOOT WIRE BOARD. PEGS AND TERMINALS.

Washington, D. C.—Washington and Brookland Street Railway; capital, $1,000,000. Incorporators, Henry Barton, T. C. Daniel and others.

Provincetown, Mass.—The Provincetown Electric Company. Directors, J. D. Hilliard, J. H. Hopkins, J. A. West, George O. Knowles and Luther Nickerson.

Ellenville, N. Y.—Ellenville Electric Company; capital, $30,000. Promoters, John H. Kemp and John B. Murray, of Delhi, N. Y., and Edwin Russell, of Ellenville, N. Y.

Greensburg, Pa.—Westmoreland Electric Company; capital, $50,000. Directors, Daniel Monaghan, John M. Stewart, Lemuel Offert, E. A. Bair, Charles Henry, James E. McFarland and John M. Brumbaugh.

Dubois, Pa.—The Citizens' Electric Light, Power and Heat Company; capital, $2,000. Promoters, Chas. E. Bostwick, J. A. Terpe, and George E. Grier, all of Dubois, Pa. Incorporation papers sent to W. C. Pentz, Dubois, Pa.

Sioux City, Ia.—Sioux City and Leeds Electric Railway Company; capital, $200,000. Incorporators, Maris Peirce, A. M. Coffman, E. M. T. Tkeny, A. W. Gates, Fairbanks, C. C. Pierce, W. E. Higman and W. M. Stevens.

Lock Haven, Pa.—Clinton County Electric Light, Heat and Power Company; capital, $25,000. Promoters, Chas. M. Blanchard, of Philadelphia, Chas. M. O'Connor and E. B. Shoemaker, both of Lock Haven, Pa. Incorporation papers sent to Henry C. Terry, Bullitt building, Philadelphia, Pa.

Holyoke, Mass.—Roland T. Oakes Company; capital, $8,000.

Marshall, Ill.—Marshall Electric Company; capital, $20,000.

Baltimore, Md.—S. D. Warfield Company; capital, $100,000.

Camden, N. J.—Pneumatic Transit Company; capital, $500,000.

Sierraville, Cal.—Sierra Valley Telegraph Company; capital, $20,000.

Elizabeth, N. J.—The Suburban Electric Company; capital, $300,000.

Chicago, Ill.—The Mercantile Telegraph Company; capital, $100,000.

Helena, Mont.—Helena Rapid Transit Company; capital, $500,000.

Denver, Colo.—The American Aluminum Company; capital, $2,000,000.

Chicago, Ill.—The Hall Chemical and Gas Company; capital, $1,500,000.

Troy, N. Y.—The National Storage Battery Company; capital, $5,000.

Steelton, Pa.—Citizens' Passenger Railway Company; capital, $100,000.

Port Townsend, Wash.—Gleman Improvement Company; capital, $100,000.

Paris, Tex.—Paris Electric Light and Railway Company; capital, $30,000.

Boston, Mass.—The Electric Power Transmission Company; capital, $500,000.

Tacoma, Wash.—Puget Sound and Pacific Railway Company; capital, $500,000.

Seattle, Wash.—Galena City Mining and Investment Company; capital, $60,000.

Seattle, Wash.—Monte Cristo Mining and Improvement Company; capital, $100,000.

Decatur, Ill.—City Electric Railway Company, of Decatur, Ill; capital, $300,000.

Aberdeen, Wash.—The Aberdeen and Victoria Railway Company; capital, $2,500,000.

Shelbyville, Ind.—Shelbyville Electric Street Railway Company; capital, $100,000.

Hoboken, N. J.—The Fair Electric and Manufacturing Company; capital, $100,000.

Deming, New Mexico.—The Deming and Utah Railway Company; capital, $3,000,000.

Lock Haven, Pa.—The Clinton County Electric Light, Heat and Power Company.

Sault Ste. Marie, Mich.—Edison Sault Ste. Marie Electric Company; capital, $57,000.

New Whatcom, Wash.—B. B. Electric Supply and Construction Company; capital, $1,000.

Clearfield, Pa.—The Citizens' Electric Light, Power and Heat Company; capital, $3,000.

Butte, Mont.—The Montana Mining, Loan and Investment Company; capital, $12,000,000.

Pittsburg, Kan.—The Forest Park Electric Street Railway Company; capital, $50,000.

Jersey City, N. J.—The American Watchman's Time Detector Company; capital, $100,000.

Port Townsend, Wash.—Baxter Park Land and Improvement Company; capital, $500,000.

Lancaster, Pa.—The Lancaster and New Holland Electric Railway Company; capital, $150,000.

Salem, Ind.—The Salem Electric Light and Artificial Ice Company, Limited; capital, $15,000. Promoters, C. C. Hauger, B. H. Cravens and Lee E. Sinclair. Incorporation papers sent to Eugene Haim, Salem, Ind.

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NEW YORK, JAN. 30, 1892.

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A sensational newspaper of this city recently contained a highly colored alleged interview with Thomas A. Edison, in which Mr. Edison is quoted as saying that he could whip Chili by playing upon the Chilian soldiers a chilly stream of water charged with an alternating current of 20,000 volts. The name of the man who is to hold the hose carrying this frigid and torrid death is not given.

We are in receipt of a very complete description, with accompanying plans, from our Paris correspondent of the proposed new electric underground railway to be constructed in the city of Paris, and which is of especial importance at the present time in view of the deep interest being taken in this country on the subject of rapid transit. This question is quite as live a one in the large cities of Europe as it is here, owing to the rapid concentration of population at these great centers, and electricity is the first favorite for motor power and lighting in all the proposed schemes of relief.

The 186th anniversary of the birth of Benjamin Franklin occurred on January 17. The occasion was celebrated by Franklin societies and printers generally. Would it not be well for electrical organizations to take a hand in perpetuating the name and fame of this great man?

The recent decision of the Court of Appeals of the State of New York in favor of the Brush Electric Illuminating Company of New York city, whereby they are declared manufacturers within the meaning of the statutes of the State, is a very important one for central station companies, and will save them thousands of dollars in the exemption from taxation which it brings.

Heating by electricity seems to be making considerable headway towards a more popular use, notwithstanding that it is more expensive than any of the older forms. It is combating the same objection that the electric light met with in its early days, but unquestionably it is a much more desirable method for most uses and will surely grow in favor. It is somewhat of a luxury at present, but as the cost of the electric current is reduced, and each year has seen an improvement in that direction, due to the use of more economical machinery and methods, it will soon reach a point of economy where its more general adoption for general purposes will be feasible.

"Old Billy," a famous car horse of the West End Street Railway Company, Boston, died at the West Lenox street stable on Christmas Day. He was a flea-bitten Morgan gray, raised in Vermont, and had reached the age of 42 years, 25 of which he had passed in the car service in Boston. It is estimated that during his long career "Billy" traveled over 125,000 miles between the car tracks, and it is a remarkable fact that he never lost a trip through sickness or inability. He had been on the retired list for several years.

"Old Billy" was evidently a more than ordinary horse. He must have breathed his last with thanks for having lived to see the emancipation of his fellows.

Here are some words from London *Engineering* which should interest American manufacturers:

"Advertising is to commerce what steam is to an engine. That is a recognized fact. A firm, even with the greatest reputation for integrity and for scrupulous adherence to superiority in products, cannot now sit still and wait till orders are received. The spirit of the age, so far as commerce is concerned, is competition, in contradistinction to the monopoly of the past. Where one firm two or three years ago was alone in the production of a commodity in an area of greater or lesser size, there are now several, all equally able, equally willing. Such firms find it profitable to create an interest in their work by keeping their names before the public, and by educating prospective clients as to their products and their mode of constructing these."

REPEAL THE LAW.

The Capital Punishment Revision Committee have made a statement to the New York legislature, by request of that body, giving their views on that clause which excludes newspaper representatives from witnessing the carrying out of the electrical execution law. These reasons, given in another column, are not based upon sound logic, and entirely ignore the fact that the methods of capital punishment adopted being novel in every way, the greatest publicity should certainly be granted, so that the thinking classes of our citizens could, from popular testimony, determine whether the results are such as to sanction its continuance or demand its repeal. So little was actually known of the subject of putting a human being to death by electricity, so much was based on theory, that the fair name of the State, yes, of the nation, was at stake, and a thoroughly unbiased report was called for as the result of open and above board inspection of the carrying out of the law. Messrs. Gerry & Company will not prevail this time though, and the press clause will have to go.

THE PATENT OFFICE.

According to the report of the Commissioner of Patents for the last fiscal year, the number of applications filed was 43,616, being a slight decrease over the preceding year, when 43,810 were filed, though both years showed a large increase over preceding years. There was turned into the United States Treasury during the year, to the credit of the patent fund, $157,291.69, swelling the whole balance in the treasury to the credit of patent fund to $3,947,847. Notwithstanding the large sum which the inventors have put into Uncle Sam's pockets, the Commissioner is forced to again cry out for room enough to properly transact business. The Land Office and the General Offices of the Interior Department are permitted to occupy the choice rooms of a building paid for out of the patent fund, and the inventors and their attorneys are obliged to endure the greatest inconvenience in transacting their business. In addition to this unjust treatment of a class of whom the country has more reason to be proud than of any other, the Patent Office is permitted to worry along with a force utterly inadequate to handle its business. Inventors' applications are obliged to sleep for an average of three months, and in many cases over five months, in the Patent Office before they are considered, a proceeding costing an incalculable amount of annoyance by hampering commercial negotiations, and inviting interference contests which wear out the patience and soon deplete the purse of a poor inventor. This is a crying shame—it has been crying so long that it has gone well-nigh into hysterics by this time. It looks as if the Commissioner of Patents will have to talk himself hoarse to catch the ear of Congress, which is unfortunately more sensitive to prods than to logic. Here is a glowing opportunity for the Inventors' Association to show the stuff it is made of.

The commissioner again urges legislation to remove the unjust discrimination against American inventors, which shortens the patent term if a foreign patent be taken before issue of the domestic patent. The intention of the statute was to prevent continuance of a monopoly here which is free abroad. It is a mistaken idea. Not one patent in a thousand is patented in European countries, so that almost all patents will be free somewhere during their continuance in the United States, and if it were not so, a little juggling which any attorney understands enables the foreign and domestic patent to issue simultaneously, so that the object of the statute is defeated.

Let us hope in the face of despair that something will be done by this Congress. In view of the near approach of a presidential election, economy to a degree which is parsimony is likely to be the rule; we are, therefore, following a forlorn hope in looking for relief in the near future.

The National Electric Light Association will be able to make a more favorable showing at Buffalo than ever before in its history, both as regards practical work done and also in its financial status. This Association, we think it safe to predict, will, in its field, become one of the most powerful bodies for good in the realms of electricity, and that in the near future. The central station companies all over the country are awakening to a realizing sense of the importance of this body in the furthering and conserving of their best interests, and a due appreciation of the value of a membership is the result. There are now some 1,700 central station companies engaged in supplying light and power for commercial purposes, and a membership of even one half this number will make the Association a most important factor. The membership is rapidly growing, and the governing board is on the alert to increase the efficiency of the organization. We advise all to step into the ranks and help the good work along.

Mayor Boody, of Brooklyn, has, it is stated, determined not to act on the recent resolution of the board of aldermen, permiting the use of the trolley by the street railroad companies. The resolution will become a law at the expiration of ten days from the date of its passage, should the Mayor not interpose his veto.

CORRESPONDENCE.

OUR INDIANAPOLIS LETTER.

Mr. W. H. Schott, of the Western Electric Company, of Chicago, was in the city this week. He is installing a plant of 150 arc lamps for street lighting at Muncie, Ind.

Mr. Harper, formerly with the Citizens' Street Railway Company, of this city, is now traveling for the Central Thomson-Houston Electric Company, of Cincinnati.

Mr. J. W. Cleary, of the National Electric Headlight Company, of this city, has gone to La Fayette, Ind., to witness a trial of their headlight on a model engine of the Purdue University.

The Strike of the street railway employés of this city which lasted four days, was declared off, at a public meeting held at Tomlinson Hall, on Wednesday night. A large parade was made by the different labor organizations before going to the hall.

The Edison General Electric Company, are installing an immense plant in the Indiana hospital for the insane; it comprises the engines, boilers, dynamos, etc., and over 3,300 incandescent lights. Mr. Hand is the superintendent in charge of this work, amounting to $35,000.

Among the Visitors here this last week were: Mr. James, representing the Kellogg Oil Company; Mr. P. S. Kingsland, of Chicago, general western manager of the Phœnix Iron Works Company; and Mr. F. A. Wunder, agent of the Western Electric Company, of Chicago; and also Mr. Gooch, of the Cincinnati office of the Edison General Electric Company. VOLT.

Indianapolis, January 23.

OUR CHICAGO LETTER.

Mr. J. A. Seymour, of McIntosh, Seymour & Company, Auburn, N. Y., made a brief visit to Chicago this week.

Mr. W. A. Smith, general manager of the Omaha Street Railway Company, is in Chicago this week.

At a Meeting of the Chicago Electric Club, held Monday evening, a resolution was made and accepted to form a stock company, thereby entirely reorganizing the Club. It is further proposed to secure larger and more commodious quarters for the Club, in order to be better prepared to take care of the electrical fraternity during the World's Fair.

A Member of the sub-committee on streets and alleys of the South Division will have a conference to-day with ex-Judge Grinnell, representing the Chicago City Railway Company, regarding the ordinance for the loop now pending in the committee. It is reported that the company will accede to the demand for cross-town lines made by the aldermen, provided it is permitted to operate the cars by electricity.

In Another column Mr. W. R. B. Willcox furnishes some figures on electric heating, which will be read with interest not only by managers of electric street roads and central stations, but also by all interested in electrical matters. Mr. Willcox has made a close study of heating in general, and has become an enthusiast in the cause of electric heating. While it may not be wise for us to throw out our stoves and furnaces entirely at present, yet is gratifying to know that the company with which Mr. Willcox is connected is now furnishing electric heaters which supply a pleasant, healthy and sufficient heat to the patrons of about 100 electric roads as well as to quite a number of houses, and that further experiments are being made with a view of making not only a practical, but economical heater for household purposes. M. J. B.

Chicago, January 23.

OUR BOSTON LETTER.

The Merrimac Valley Street Railway, at Lawrence, Mass., is to be equipped throughout with the overhead trolley system of the Thomson-Houston Electric Company.

The American Electric Company, has established offices at No. 38 Bedford street, this city, and will manufacture a variety of electrical novelties, the most important being the "New Era" electric gas lighter.

Mr. Herbert C. Wirt stated to the writer, recently, that he had won his patent suit before the patent commissioner, on an appeal from the examiner-in-chief, awarding him (Wirt) priority of patent on the "K. & W." rosette cut-out.

Hon. J. M. Allen, president of the Hartford Steam Boiler Insurance and Inspection Company, was one of the guests at the Chamber of Commerce dinner recently, representing the Hartford Board of Trade, of which he is the president.

The Uxbridge, Mass., Electric Light Company, held a meeting at Worcester, on Friday, January 22, and declared a semi-annual dividend of two per cent. The purchase of property at Riverdale, Mass., for a new power plant was discussed.

Lewiston, Maine.—At the annual meeting of the Lewiston and Auburn Electric Light Company, Monday, January 18, the old board of officers was re-elected. The reported earnings of the company during the year just ended is $6,250 more than in 1890.

Messrs. Kendall & Slade, electrical engineers and contractors of this city, have removed their offices and salesroom to No. 134 Congress street. This enterprising young firm have been successful in the installation of several large electric light plants and power stations in New England.

Lowell, Mass.—The power for the Lowell and Suburban Street Railway will be supplied by six boilers of 1,000 horse-power capacity, made by Scannell & Wholey, of that city. The contract says that everything must be in place by March 15. The concern has been largely engaged on local work lately.

Boston, January 23. W. I. B.

National Electric Light Association.

Secretary George F. Porter is sending the following letter to central station companies which are not members of the Association:

NEW YORK, January 22, 1892.

Gentlemen: Great interest is being taken in the coming fifteenth convention of this Association, to be held in Buffalo, N. Y., February 23, 24 and 25 next. Knowing you to be interested in central station management, I take the liberty of calling your attention to the great benefits accruing from attending these meetings.

The papers to be read at Buffalo are from men high in the science, and will treat on every valuable subject from "How to Fire a Steam Boiler" to "Electric Lighting from a Financial Standpoint," including the steam engine, dynamo, switchboards, overhead and underground wiring, motors, etc.

We would be pleased to enroll you among our already large membership, and hope to welcome your representative at Buffalo. Will you be with us?

Very respectfully,
GEORGE F. PORTER, Secretary.

Electric Heating.

CHICAGO, January 21, 1891.

TO THE EDITOR OF ELECTRICAL REVIEW:

In your issue of January 23 I notice with interest the remarks of Mr. Pearson, of the West End Street Railway, Boston, upon the subject of electrical heating. I ask space in your estimable paper to express my own pleasure and that of others occupied with that young branch of the electrical industry at seeing so able and practical an electrician taking a lively interest in its progress. From personal acquaintance, as well as his words, I can say that Mr. Pearson is enthusiastic at the prospect of inexpensive electrical heat in the near future.

In his position of electrical engineer for the West End Road, he has been able to watch the results of electrical heaters now being used upon 20 cars of that system, and the fact that they are the most desirable form of heater he evidently does not question. In the communication to your paper, the circumstance of the St. Louis apartment house, experimenting with electrical heaters is mentioned and comment is made that the time is not far distant when electrical heat will replace that of coal or other fuel. To quote: "before long we will not only have our houses heated, but, with the same wire which serves to heat, we will be able to cook our meals and light our houses." Not eight months ago, a New York paper characterized similar words from the pen of a contributor to one of the electrical papers as those of a promotor. I do not believe that Mr. Pearson is interested in the sale of electrical heaters, except as one wishing comfort and happiness to all mankind. His words express his unprejudiced opinion formed after personal observation and calculation.

I would emphasize the fact, that electrical house heaters would give no more bother than steam radiators. Indeed, they would not give as much bother, nor take up so much space. Heat from an electrical heater, the size of an ordinary house radiator, would make a room unbearable; if divided and distributed, it would do for five rooms. Moreover, from the electrical heater, there is no escaping steam or water, and with them rattling steam pipes are unknown.

Mr. Pearson's one objection seems to be the cost of operation which, although in his present opinion, is somewhat excessive, he believes nevertheless that it will soon be decreased, owing to the altered methods of electric plants—the installation of larger engines. It would be interesting to know Mr. Pearson's exact figures in reckoning the cost in operating electrical heaters. Having at hand reports from several electric railways using the Burton electric heater, I choose indiscriminately those of two roads. That of the first is, in substance, as follows:

3 amperes or 2 horse-power per set of 4 heaters.
4 pounds of coal per horse-power per hour.
144 pounds of coal per 18 hours per car day.
Cost of coal, $1.75 per ton.
1 pound of coal, $.000875.
144 pounds of coal, $.12528.
Cost per car day, $.12¾.
Cost of stove heat in this case, $.25 per car day.

That of the second, in substance, as follows:

3 amperes or 2 horse-power per set of 4 heaters.
4 pounds of coal per horse-power per hour.
80 pounds of coal per 10 hours per car day.
Cost of coal, $3.75 per ton.
1 pound of coal, $.001875.
80 pounds of coal, $.15.
Cost per car day, $.15.
Cost of stove heat in this case, $.35 per car day.

I have reports from other roads which tell approximately the same story.

I infer that Mr. Pearson spoke more especially of expense in relation to house heating by electricity when he said that it was five times that of prevailing methods. I agree with him that at present the expense of heating houses by electricity is in excess of that of doing the same thing by other means, but with the improvements in generating facilities, which are rapidly succeeding each other, I see, as do all who have given the matter even slight attention, cheap electrical heat available for homes and offices before many days. While a reduction in the cost of current will be perhaps the chief cause of lessening the expense of operating electrical heaters, earnest work is in progress to increase the efficiency of the heaters themselves, in order that the greatest possible amount of heat may be obtained from a given amount of current.

I eagerly lend my voice in urging an early utilization of the unlimited power in the numerous waterfalls of our country to reduce the cost of current. It means the bringing of pure light and heat into thousands of homes. Some localities have realized the incomparable service waterfalls may do in this particular work. In isolated cases in Canada, Montana, New York, Indiana, etc., some houses are now being warmed by electricity, and that at little expense, since the generation of current at a neighboring waterfall costs almost nothing.

Yours truly,
W. R. B. WILLCOX.

PERSONAL.

Prof. Alexander Graham Bell sailed for Europe, January 23 on the "Werra."

Henry A. Hubbell has been elected secretary of the Bryant Electric Company.

Capt. W. L. Candee, of the International Okonite Company, has returned to New York after a month's trip to England.

Paul T. Brady has been elected manager and treasurer of the Central Thomson-Houston Electric Light Company, of Syracuse, N. Y.

Mr. Nikola Tesla sailed for Europe on the "Umbria" on the 16th inst., and will lecture before various electrical societies in Europe. He will be gone several weeks.

General Manager C. A. Coffin, of the Thomson-Houston Electric Company, and Mrs. Coffin were recently guests of President and Mrs. Harrison at the executive mansion.

William G. Lindsay, formerly purchasing agent for the Westinghouse Electric and Manufacturing Company, has gone into the mine and mill supply business with W. E. Frick, of John A. Roeblings' Sons.

The suit of Frank J. Sprague, against Field, Lindley, Wiechers & Co., to recover stock of the Edison General Electric Company, alleged to have been stolen by Field, has been discontinued by order of Judge Patterson. Mr. Sprague, through his attorneys, first obtained an injunction restraining the firm and the assignee Charles W. Gould, from disposing of the stock. The supposed reason for discontinuing the suit is, that the stock had been disposed of before the injunction was granted. Field has been indicted for stealing it.

War with Chili would be likely to make considerable difference to the Thomson-Houston Company. In the first place, Captain Eugene Griffin, one of the vice-presidents and a very important wheel in the machinery, would be likely to have his leave of absence revoked and have to take the field. Then there is Lieut. E. J. Spencer, who has just been placed in charge of the company's coming exhibit at the Worlds' Fair, who is also on a leave of absence from the regular army. His friends would expect great things from him in case of war. Lieut. W. M. Wood, of the projectile factory belongs to the navy. Lieut. J. B. Cahoon was in the navy but has resigned and is not likely to be called upon. In addition to these, many young men in the offices of the electric and welding companies belong to the naval battalion and might be drafted.

Opening of the Crystal Palace Electrical Exhibition.

(From a London Correspondent.)

The Crystal Palace is once more the scene of electrical activity. Ten years have elapsed since an electrical exhibition was held in the same building, and at that time electricity, or rather its applications, was in its infancy. It will be unnecessary to refer to the remarkable development which has taken place in the interval. The present exhibition, which was opened to the public on the 9th inst, owes its origin to the Crystal Palace Company, as did its predecessor, and the directors of the company invited, on the previous day, the press to a private view of exhibition and also provided a substantial luncheon.

Nearly 100 representatives of the press, including those of the electrical and engineering journals, were present at the luncheon, which was presided over by Mr. Henshaw Russell, the manager of the Crystal Palace Company, and to whose exertions the present status of the exhibition is mainly due. Strange to say, not one electrical engineer was requested to toast the success of the exhibition, this duty, for some unaccountable reason, being performed by a representative of a weekly publication devoted to the iron trades. At the close of the luncheon, the guests separated and inspected the exhibits. It cannot be said that the exhibition is complete, but what is on view makes a capital show of all kinds of electrical machinery and apparatus. The exhibition is divided into the following sections: (A) Phenomena and laws of electricity; (B) electrical measurements; (C) primary and secondary batteries; (D) dynamical electricity; (E) transmission, distribution and regulation of the electric current; (F) electromotors; (G) application of electromotors; (H) electric lighting; (I) electric heating; (J) electrometallurgy; (K) electric welding; (L) telegraphy; (M) the telephone; (N) electricity in surgery and therapeutics; (O) various applications of electricity; (P) history and statistics of electric lighting. It will be evident that the scope of the exhibition is very wide, but in this *resumé* of some of the most interesting features, it will only be possible to give an outline.

In the machine room are to be seen modern types of boilers, engines and dynamos by different makers, and which have found favor in isolated installations and central stations in this country. Here we find representative exhibits of the Brush Electrical Engineering Company, Limited, Crompton & Company, the Electric Construction Corporation, Easton & Anderson, Johnson & Phillips, Davey, Patman & Company, Laing, Wharton & Down, Siemens Bros. & Company. Various types of gas engines are shown, and altogether the machine room is decidedly interesting. The current generated by the different dynamos is used for all kinds of purposes in and about the building. One of the most interesting features in the North Nave is a large vertical wire screen extending upwards to the roof. This screen has arranged on it 10,000 Edison-Swan incandescent lamps in one group, and these will, by means of switches, be caused to show various devices. Another feature is a large search light erected on top of a conning tower as on a vessel, and the light will be projected from one end of the palace to the other. As regards telephony, opportunities are afforded visitors of listening to operatic performances in London and in the provinces, and even as far as Liverpool. A special feature in the galleries is the arrangement by various contractors of series of rooms erected so as to show different methods in style and finish, and effect of electric lighting in the household.

It is proposed to hold conferences during the period of the exhibition, and also to have papers read dealing with the subjects of the exhibition, much in a similar manner as was done at the recent electrical exhibition at Frankfort. The exhibition does not possess any remarkably striking points, as, for instance, in the electrical transmission of power, but it is throughout exceedingly interesting. It will, doubtless, be a very successful enterprise, being supported by the lord mayor of London, the London chamber of commerce and nearly the whole of the electrical trades. A. W.

Telephonic News

*** Total number of subscribers connected by the Erie Telephone Company's sub-companies is 14,011.

*** The actual amount of cash invested in the public telephone business of this country is about $75,000,000, not including patents.

*** The Hudson River Telephone Company commenced the building of metallic circuits connecting Fonda, Johnstown and Gloversville with Amsterdam.

*** At a recent fire on Thirteenth avenue, New York city, the Metropolitan Telephone Company's long distance lines running out of the city were seriously injured.

*** The Long Distance Telephone line has reached as far West as Akron, O. This station will be the terminal for the present, and extension work will not be resumed till Spring.

*** It is more than probable that telephone connection between Bowling Green, Rich Pond, Woodburn and Franklin, Ky., will soon be established; subscriptions are being raised for the purpose.

*** The Police Commissioners of New York have requested the Manhattan Elevated Railroad Company to permit the police telephone and telegraph wires to be strung along the elevated structure.

*** The Chicago Telephone Company has increased its capital stock from $2,000,000 to $5,000,000, and proposes to increase its facilities in time for the Worlds' Fair. This company has been paying dividends of from 2 to 2½ per cent. per month, and the stock is worth 235.

*** A bill was recently introduced in the Ohio State legislature fixing telephone rates. It divides cities into two classes, depending on population, the dividing line being drawn at 25,000 inhabitants. In those having over that number the rental must not exceed $4 per month, and in those having less the rental is to be not over $3.

Central Station Electric Light Companies Manufacturers.

The Brush Electric Illuminating Company, of New York city, have recently won a very important suit before the court of appeals, in which it claimed that central station companies supplying electricity for light and power were manufacturers within the meaning of the statutes of the State. This decision carries with it under the law an exemption from State taxation.

Election of Officers.

At the annual meeting of stockholders of the Crocker-Wheeler Electric Motor Company, the following officers and directors were elected for the ensuing year: S. S. Wheeler, president; F. B. Crocker, vice-president and treasurer; D. H. Jeffery, secretary; R. N. Peterson, S. S. Wheeler, F. B. Crocker, David Crocker, A. F. Higgins, W. B. Baldwin and F. M. Jeffery, directors. This company is pushing the manufacture of its goods vigorously in order to have a large supply of motors in stock for the Spring trade.

Pittsburgh Electric Club.

President Morris W. Mead, of the Pittsburgh Electric Club, has appointed the following committees for the government of the Club:

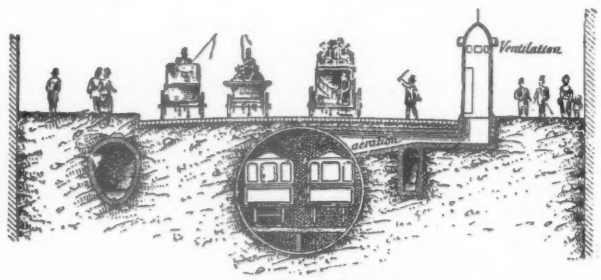
House Committee: N. H. Byam, chairman; H. F. Albright and F. H. Ketchum. Entertainment Committee: E. H. Heinrichs, chairman; W. McC. Ramsey and E. B. Thompson. Membership Committee: John Campbell, chairman; D. W. Dunn and H. McL. Harding.

At a recent meeting of the board of directors, Mr. Ernest H. Heinrichs, of the Westinghouse Electric and Manufacturing Company, was elected librarian and historian of the Club.

The Paris Underground Electric Railway.

The construction of the proposed underground electric railway for Paris will probably commence May 1, 1892, and it will require two years to complete it according to the statement of the engineer, J. B. Berlier, of the Compagnie Les Tramways Tubulaires Souterrains de Paris.

As the question of rapid transit in New York city and Chicago is now exciting much comment, it will be of interest to many to see the methods to be used in the construction at Paris.



— Mode d'aération.

FIG. 1.—THE PARIS UNDERGROUND ELECTRIC RAILWAY.

The total cost of the tunnel and equipment will be 54,000,000 francs, or 4,500 francs per metre for the tunnel, and an expenditure of 200,000 francs for each station.

The total length of the line first to be built is 6.1 miles (11 kilometres), and will extend from Bois de Boulogne (Fig. 2) across the city to the Porte de Vincennes. The entire system is divided into three lines; the first connects the Place de la Concorde to the Bois de Boulogne, and is to have five stations; the second will start at Place de la Concorde and end at the Place de la Bastille, passing under Rue Royale and under the grand boulevards (Fig. 4) with seven stations along the line; the third line will extend from Place de la Concorde to the Porte de Vincennes, and will be connected to the first two. The whole system will be underground except at the bassin de l'Arsenal which will be a viaduct.

The tunnel is to be water tight and constructed of cast iron plates (1.5 metres) 1½ metres long, 50 centimetres (½ metre) wide and 2½ centimetres thick. These plates will be so put together as to form a tube 5.6 metres in diameter, and the tunnel will be constructed in the same manner as that at London, by hydraulic presses. The ventilation is accomplished by shafts placed along the tunnel at intervals (Fig. 1) of 50 metres, and Mr. Berlier claims that the movement of the trains will be sufficient to insure perfect ventilation. He also claims that many people will prefer traveling in the tunnel to being rattled about in the omnibuses used at the present time, for it will be very comfortable traveling as the tunnels will be lighted throughout with incandescent lamps, the stations with arc lamps and the carriages with electric lights varying from 10 to 35 candle-power each, and the temperature in the tunnel will be more uniform than in the streets, being cooler in Summer and warmer in Winter, while the only thing to contaminate the atmosphere of the tunnel will be the respiration of the passengers, as there is no smoke and no use of oxygen for gas or other lights. The stations are 25 to 30 metres long and 15 metres wide (Fig. 3), and large staircases will lead to the street, while at the stations at Arc de Triomphe and Gare de Lyon there will be electric elevators. The tunnel is to be placed 1.5 metres below the surface of the street as a minimum, and the maximum depth is at the Arc de Triomphe, where it is 18 metres below, and hence an elevator is necessary at this point. The heaviest grade is at the Place de la Bastille, where the road passes over the canal; at this point for over 20 metres the grade is six per cent. or six centimetres per metre.

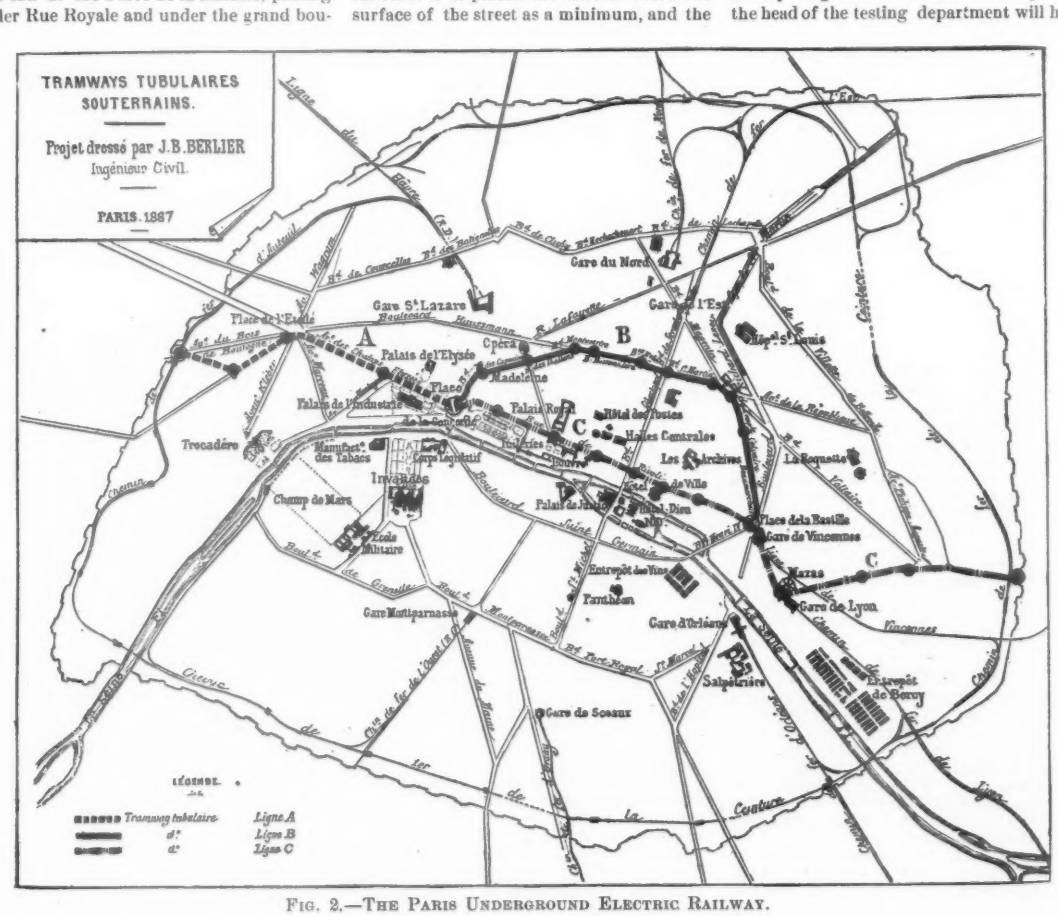


FIG. 2.—THE PARIS UNDERGROUND ELECTRIC RAILWAY.

The central power station will be placed underground at the Place de la Bastille, and will have a total capacity of 4,000 horse-power. The reason it was placed at this point is that water can be had from the canal and coal can also be easily transferred to the station from the canal boats. There are to be 40 electric generators of 100 horse-power each, with a potential of 400 volts. Two generators to be connected directly to one steam engine, making a total of 20 triple expansion engines of 200 horse-power each. The carriages are each to have a total length of 12 metres. Those cars having first class compartments will seat 18 first class passengers, and also have an apartment for 16 second class passengers. The cars for second class passengers alone will seat 56 passengers. Trains will run every two minutes and the speed will be about 25 kilometres per hour. The rails are one metre apart, and the current is conducted to the motors from a center rail by brushes under the car. Each motor car will have two motors of 25 horse-power each, and a train will consist of four cars, a motor car in front and one in the rear with two other cars between. Sixty trains will be kept in continual operation during the busy hours of the day. The rails used are to have a weight of 25 kilograms to the metre, and will be of the ordinary type used on the elevated roads in New York.

The trains will be equipped with both air brakes and electric brakes; the electric brakes being in general use and the air brakes held in reserve in case of accident. The doors of the carriages will be opened and closed electrically on the trains arriving at and departing from the stations; in this way many accidents may be avoided. Mr. J. B. Berlier places the total cost at 54,000,000 francs, but many believe it will exceed this figure.

FRANK C. PERKINS.

Thomson-Houston Company at the World's Fair.

It is stated that the exhibit of the Thomson-Houston Company at Chicago will be on a very large scale. Lieut. E. J. Spencer, the head of the testing department will have charge of the work. The various associated companies scattered all over the country will combine in the display, taking up at least 20,000 square feet of space. Among the companies to be represented in the exhibition will be the Thomson-Houston Electric Company, Thomson-Houston Motor Company, Thomson-Van Depoele Mining Company, Thomson Welding Company, Brush Electric Company, Fort Wayne Electric Company, Short Electric Railway Company and the Thomson-Houston International Electric Company.

The Western Union's New Operating Rooms at 195 Broadway.

The metropolitan press was invited on January 20, to visit the new operating department of the Western Union Telegraph Company at 195 Broadway, New York. This is the Phœnix which has arisen from the ruins of the upper part of the building, occasioned by fire some months ago. This department of the Western Union Company's immense business is situated on the seventh and eighth floors of the remodeled building.

The dimensions of each of these floors are 75x200 feet, having windows on all sides, 36 on each floor, ranging in width from 5 to 14 feet. At night, light is furnished from 600 incandescent lamps. At the east, or Broadway end of the seventh floor is the superintendent's office. At the west end is the bookkeeping department; between them is the commercial news department, which collects and distributes the quotation service. Here we find stock, grain, oil, cotton, coffee, financial and general news tickers, besides Morse wires, connecting with all the exchanges and all the principal cities of the country—a veritable museum by the variety of its instruments and service. Operators, clerks and office messengers are here, each moving with machine-like precision, and where time, between 10 A. M. and 3 A. M.—exchange hours—is noted to the fraction of a second. On this floor, also, the wires leased to brokers, newspapers, etc., are connected, and scores of electrical experts are kept constantly moving, adjusting the various repeaters, duplexes, quaduplexes and other instruments. Here too, are the wires worked by the Wheatstone automatic system. Thirty or more "punchers," as the demands of the service require, prepare the messages for transmission by this system, and as many typewriters copy the messages from the slips as they roll out from the receiving instruments.

Next to the Wheatstone service and near to the bookkeeping department, where the files of messages are kept, are the assorters, inspectors and service clerks; the first keeping the business of the office arranged in alphabetical order of place and destination, the second noting that every message bears proper indication of transmission, and the service clerks making or attending to any necessary inquiries. On the eighth floor are the wires to the southern, eastern and western points, also the city of Long Island and suburban wires. On this floor are accommodations for upwards of 1,000 operators and other employés. Here are the Simplex, Morse, Duplex, Quadruplex, Phelps' motor, printer's and marine circuits, the latter to Quarantine, Highlands, Sandy Hook, City Island, Fire Island, also the special circuits for the transmission and reception of United States government weather signals. These signals as fast as received are exchanged on the different circuits, those from the East being sent West and South, those from the South being sent East and West and those from the West being sent East and South, and simultaneously they are also sent by tube to 120 Broadway, signal observer's New York office. Over the marine circuits are received the reports of all incoming steamers and other vessels. On the other general circuits are transmitted and received business to and from all points in the United States and Canada land line circuits, in connection with the European, Bermuda, Nassau, Cuba, West Indies and South American cable stations are also worked from this floor jointly, or separately, with the service at the central cable office, 16 Broad street, from which latter office there are also worked by the recorder system the two ocean cables to Europe. These cables and land lines are also connected into the office at the Stock Exchange, and in addition thereto direct wires from all cable centers of the country are connected at and worked from the "central cable" and "Stock Exchange" offices. In connection with the cable service it may be well to state that the direct wire from the central cable office to San Francisco, the longest in the world, is 3,348 miles in length and that the next longest is that to Galveston, 1,820 miles. These circuits are worked duplex messages between the seventh and eighth floors and from any section of one floor to another section of the same floor, and the same with regard to any section on the other floor, are handled by a cable carrier system at a rate of speed of about 750 feet per minute. There are 75 stations. Crocker-Wheeler motors furnish power to operate the cable carrier system.

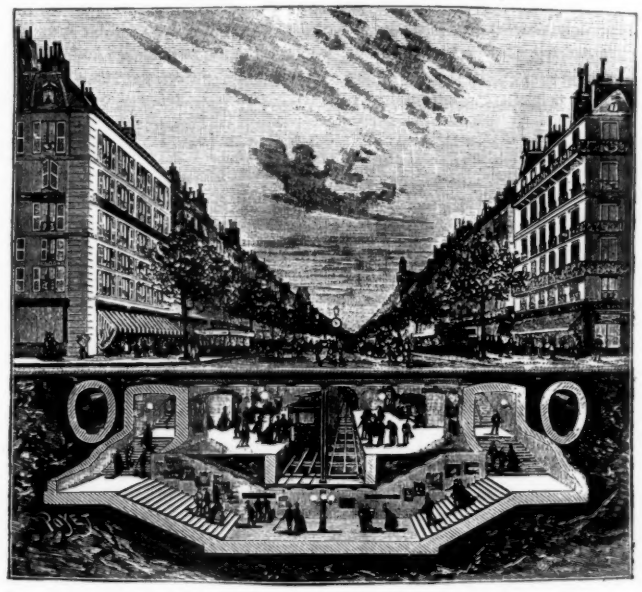


FIG. 3.—THE PARIS UNDERGROUND ELECTRIC RAILWAY.

On the gallery in the center and on the north side of the room the entire business of the two floors is handled by an efficient corps of assorters and distributing clerks—veritable living geographies. The pneumatic tubes are on this gallery in connection with the receiving and delivery departments on the basement floor, and with the several offices and floors of the building, also with downtown exchanges, and with the 8 West Twenty-third street Western Union building and intermediate uptown offices. The pneumatic tubes to the newspaper offices are worked from the delivery department on the basement floor. There are also on this gallery two revolving belts to facilitate the passage of business to and from the pneumatic tubes and carriers.

Thirty-six cables containing conductors enter the building underground to the test board in the cellar. This test board will accommodate about 3,500 wires. From it the wires lead in 100-wire cables to the operating department floors. On the seventh floor there are four switchboards, and on the eighth, six, with an almost unlimited capacity for wires and loops. The wires are brought from the test board in cellar through pipes, and are carried in cables of from four to 100 conductors each through trenches under the floors to the several switchboards. These trenches are 10 inches wide by three to five inches deep, and their combined length is about one mile. The weight of these cables in the trenches under the floors is about five tons, and the length of the wires in these cables is about 200 miles. The total number of flexible switch cords in connection with the various switchboards is about 2,000. Current for the wires is generated by 41 dynamos in the cellar. There is not a cell of battery in the building. The "local" circuits—the sounders—being also worked from the dynamo. About 3,000 incandescent lamps are used in resistance to regulate the current for various purposes. One of the most interesting features in the operating department is the time service, by which the Washington noon time signals are distributed through 93 repeaters. It is simplicity itself, and yet, to the uninitiated appears to be the most complex of arrangements. There are about 25 self-winding synchronized clocks in the department.

Wardrobe facilities are on the ninth floor. The lunch room is also on this floor, where lunch is served to employés between 11.30 A. M. and 3 P. M., and again from 7 to 9 P. M. The kitchen is on the tenth floor and is supplied with all the latest improvements in the culinary art. About one-third of the 1,200 employés of the operating department are women.

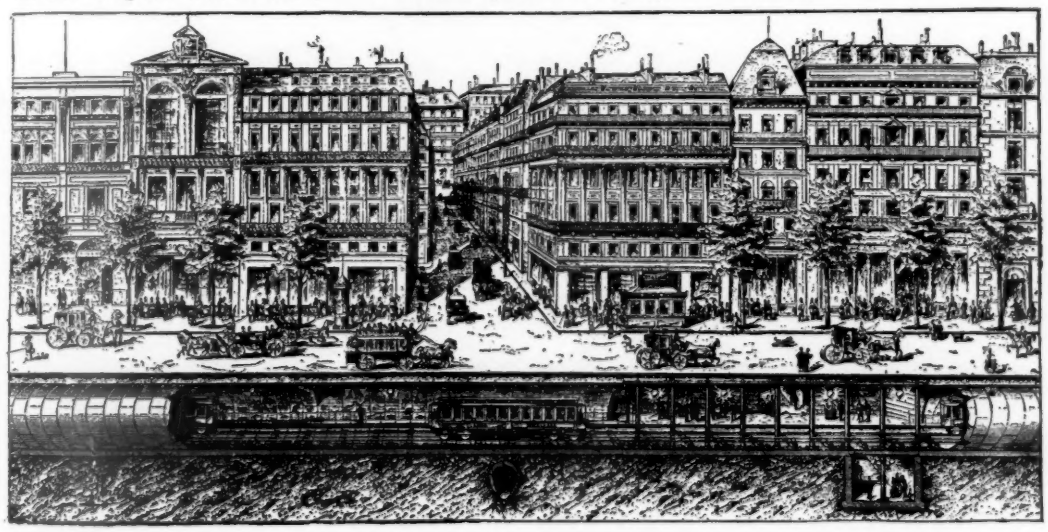


FIG. 4.—THE PARIS UNDERGROUND ELECTRIC RAILWAY.

The New York Execution Act.

The New York electrical execution commission, composed of Elbridge P. Gerry, Alfred P. Southwick and Matthew Hale, has just made a supplementary report, by request, to the legislature in reference to that portion of the execution act which excluded representatives of the press from witnessing the carrying out of the law. The commission believes that the statement of what has occurred, made in the official report, which is a public document, answers every purpose.

Although the time has expired for the poles and wires to be taken down in that section below 14th street, in New York, the Mayor is satisfied that the electrical companies have used due diligence in view of the bad weather that has recently prevailed.

TELEGRAPHIC

.... Of the men on the staff of the London telegraph department, 800 are disabled on account of influenza.

.... The board of public works of Detroit are endeavoring to force the telephone and telegraph companies of that city to place their wires underground.

.... The Postal Telegraph Company has established an office in the trading room of the Boston Chamber of Commerce with direct connections to New York Produce Exchange, Chicago Board of Trade and other centers.

.... The Anglo-American Telegraph Company, Limited, announced last week that the cable between Para and Maranham was interrupted. South American merchants, however, experienced little or no delay, as the land lines between those points were in good condition.

.... Superintendent Frost, of the American District Messenger Telegraph Company, denies the rumor that the rates are to be increased owing to the recent consolidation of that company with the Mutual. A new book of rates is soon to be issued which will be to the advantage of the public.

.... The Western Union Telegraph Company, it is stated, will shortly obtain control of the franchises of the Great Northwestern and Montreal and Dominion Telegraph Companies of Canada. Should this deal be brought about a vigorous fight between the Western Union and Canadian Pacific Companies is anticipated.

.... The Bahama Cable, from Nassau, has been landed on the Atlantic side of the narrow strip of land separating St. Lucie Sound from the sea. At the landing point, the Western Union Company will connect with the English Cable, and the office will be on the main land, almost directly west of the landing place.

.... Senator Carlyle recently introduced a bill in the United States Senate authorizing the Spaulding Telegraph Company to construct lines of underground and submarine electric conductors from Washington through Baltimore and Philadelphia to New York, and to arsenals and other military posts. The object is to provide more perfect telegraph facilities for repelling invasion and suppressing insurrection. In time of war the wires are to be at the disposal of the war department, and in time of peace may be used by that department at a nominal charge.

The Boston Horse and the Electric Car.

I'm the happiest horse in town to-night!
I go with flying feet!
For I have seen the gladdest sight
Way down on Boylston street.
And what it means I know full well;
And when I've said my say,
Down where I dwell at Horse Hotel,
There will never a horse say "neigh."

I know I'm right, and now for the sight
On Boylston street I saw—
A street car with a brilliant light,
But never a horse to draw.
It rolled along, now fast, now slow,
Steady and straight on the track;
But what made it go. I'm sure I don't know—
There was no horse front or back.

It looked like the other cars in town;
Yet there's something strange, I feel;
To-night I saw, on looking down,
The lightning under the wheel.
I heard things out of the common rule—
Strange words I never knew;
Yet I'm not a fool; I have been to school
To Mister Bartholomew.

I am simply a slave; but my freedom is won!
The thought thrills through my soul!
If without a horse one car can run,
Why cannot a thousand roll?
I'm tied to the track; one day from my back
The harness will drop at my feet,
And I shall be free; no work then for me
On the track of the stony street.

With a sniff and snort, and a toss of my head,
And a flirt of my flying feet,
I will take my bones from the pavement stones
To the prairie soft and sweet!
And day and night I shall owe my flight,
And the joys I there shall meet,
And my freedom bright to the strange, strange sight
That I saw on Boylston street.

—*Best Things.*

* * Perryville, Mo., is talking of an electric railroad.

* * Sandusky and Norwalk, O., are both talking of building electric railways.

* * The Eddy Electric Company has declared a quarterly dividend of 2½ per cent.

* * The Connecticut Motor Company of Plantsville, Conn., has called a meeting of its creditors.

* * The American Aluminum Company is contemplating erecting a reduction plant at Denver, Colo.

* * An electric road between Wellsville, O., and Mt. Union, by way of Salem and New Lisbon, is rumored.

* * Under the new reciprocity treaties with the British West Indies and Salvador, American electrical supplies and apparatus are to be admitted free of duty.

* * The Hamilton Street Railway Company of Hamilton, Canada, will change to electricity for motive power.

* * The West End street car line of Pittsburgh, Pa., has decided to adopt electricity as the motive power.

* * An electric locomotive has been ordered by the Atlanta and Chattahoochee Railroad. It will draw freight cars on that line and will weigh 20 tons.

* * G. Mortimer Lewis, who is at the head of a syndicate to build an electric road from Scranton to Carbondale, Pa., says that the work will surely be commenced in the Spring.

* * It is proposed to construct an electric railroad across the country from Dravosburg to Six Mile Ferry, to make a short line to Pittsburgh from McKeesport and surrounding towns.

* * A steam drum on the lower floor of the power station of the Thomson-Houston Electric Company's works at Lynn, exploded recently and seriously injured three men, one of whom may die.

* * The car shed of the Robinson Electric Street Railway Company, at Toledo, O., was destroyed by fire on the 19th inst. Thirty-five cars were burned, and the total loss is estimated at $150,000.

* * Receiver Winters, of the Macon Street Electric Railway, of Macon, Ga., has petitioned to be allowed either to sell the road or issue certificates with which to build a power plant of its own.

* * In reply to numerous letters of inquiry sent out by Mayor Boody, of Brooklyn, he has received communications from the Mayors of Albany, Lowell, Pittsburgh and others, all favorable to the trolley system.

* * The Uniontown Street Railway Company, whose power house and barn was burned recently, have let the contract for the electrical equipment of their line to the Edison General Electric Company. The work is to be finished in 60 days.

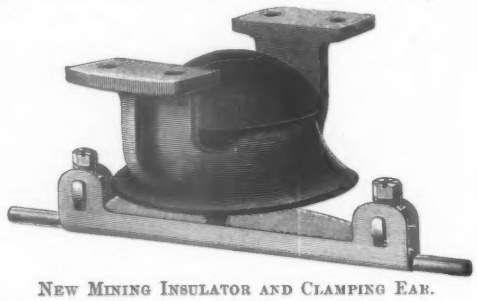
* * A stock company is being organized with $50,000 capital to construct and operate an electric street railway between Waltham and Watertown, Mass. The gentlemen prominently interested are Francis Butterick, of Waltham, and J. S. Gleason, of Watertown.

* * E. P. Curtis, H. S. Searles and Henry S. Pratt, of the board of directors of the North End Street Railway, in Worcester, Mass., recently visited Chester, Pa., to inspect the operation of the storage battery system in use there, and returned, it is stated, well pleased with the results obtained.

New Mining Insulator and Clamping Ear.

The requirements of electrical appliances for use in mines have necessitated the production of a type varying considerably from those employed above ground, the conditions in the former case being much more severe than in the latter. The insulator and ear shown in the accompanying cut was designed for the use of the Thomson-Van Depoele Electric Mining Company, Boston, and is particularly suited to the purpose for which it was made.

The insulator body is of iron, thoroughly painted with graphite paint, to withstand the action of the sulphuric acid in the mines, the insulator itself being made of pieces of porcelain rubber or other suitable material, strong and large to withstand severe strains. Its construction is such that the insulation is entirely protected from the blows of the trolley, should it leave the trolley wire and at the same time little opportunity occurs for grounding, as the head of the hanger bolt is embedded in the porcelain or rubber, and the only joint in the insulation filled by a soft rubber washer firmly forced into position when the trolley wire ear is screwed into place.



New Mining Insulator and Clamping Ear.

The only opportunity for surface leakage is on the under side of the insulator along the surface of the cone, and as this has been corrugated the liability of leakage is reduced to a minimum.

The clamping trolley ear, which was designed by Mr. J. P. B. Fiske, of the Thomson-Houston Electric Company, is very easy to install, as no soldering is necessary. Its security is greater than any soldered ear as the wire cannot come down until the phosphor-bronze clasp is worn through. Its life is almost indefinite, as the clasp is .032 inches thick and 8 inches long.

As the clamp can be loosened in a moments time, the slack in the wire can be taken up at a little expense of time and trouble, a feature not possessed by the soldered ear.

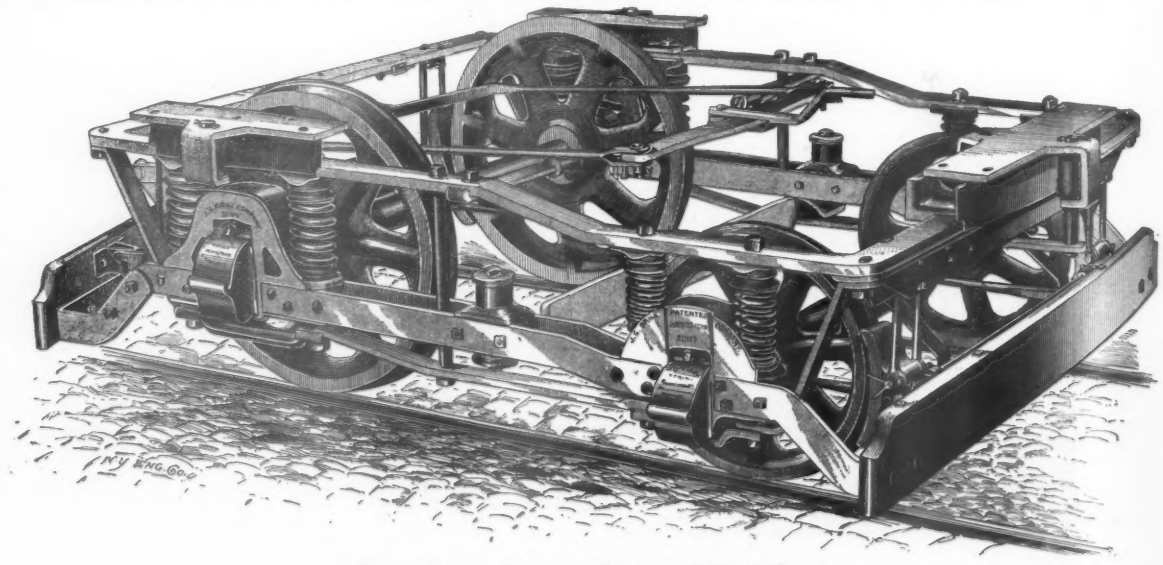
The excessive sparking which occurs with the other types of clamping ear is entirely obviated by making the bronze very thin, so that it can be easily reduced to a knife edge at the end where the trolley runs on. The clamping devices being located at the end just over the point where the trolley runs on the phosphor-bronze, the latter is sure to be pulled tight against the wire at this point, thereby securing a good fit and preventing sparking.

The clamping devices are positively locked by means of a stout German silver lock wire. It is not possible for the screw to back out even the fraction of a turn, without shearing off this wire which is quite improbable as the shearing force is practically nothing. There can be no corrosion or rusting of the clamping ear, as in its construction iron and steel have been entirely eliminated.

Brill's Eureka Maximum Traction Pivotal Truck.

One of the greatest inventions ever made in pivotal trucks for electric propulsion was John A. Brill's maximum-traction truck. In this truck many of the disadvantages of other pivotal trucks were overcome and a gain made of 42½ per cent in traction. A reduction in the height of car body ten inches, and thus the necessity for double steps was obviated; a shortening of wheel base and also reducing amount of power required by as high as even 30 per cent. The only objectionable feature, and not a serious objection, was that the pivotal center or drawing point which came over the axle was in the way in removing the motor and had to be taken off, which trouble was solved by use of the movable spider.

But being the pioneers and still leading the van in the great field of electric trucks, the J. G. Brill Company determined not to stop in improving until they had approached more nearly to perfection. This point they have reached in their new model, appropriately named the Eureka maximum-traction truck. In this truck the above named objection has been overcome. It has no mechanical pivot, and is specially adapted for the "waterproof" and "ironclad" types of motors which have their upper portion hinged so that they can be raised when it is necessary to get at the armature or other parts of motor. The space above that occupied by the motor is free and clear, so that when the trap doors in the cars are raised the whole of the motor can be reached and the armature taken out without removing or disturbing any part of the truck. Also a further reduction of height of the car to the extent of one and a half inches is obtained, and the weight of truck reduced by 150 pounds.



Brill's Eureka Maximum Traction Pivotal Truck.

The pivoting in this truck is accomplished by the combination of rollers on the side of the rub plates on the upper part of the truck. The drawing (draught) of the truck and car body is done from the small end of the truck, and this feature affords additional means of keeping the small wheels from climbing the rails. Since the introduction of the maximum-traction truck, several hundred of them have been sold and are in operation.

Recently a committee, consisting of Councilmen Snyder, McKee and Heckel, was appointed by the town of Etna, Pa., to investigate electric street lighting in its interests.

The New Baltimore Tunnel.

The projectors of the tunnel now being constructed under the city of Baltimore to connect the Philadelphia division of the Baltimore and Ohio with its Washington branch and main line, propose to light it by electricity and use the same force for motive power in order to have it perfectly free from smoke and vapor.

There was some question as to whether electricity could be used for power owing to the heavy trains that will be carried through the tunnel, but Professor Duncan, of Johns Hopkins University, says that there will be no difficulty in this respect. Electricity may be used if desired.

National Electric Light Association.

The coming meeting of the National Electric Light Association is on the boom, and everything points to a very successful convention. Mr. Huntley, its president, was recently captured by a Buffalo *Commercial Advertiser* representative with the following result:

Mr. C. R. Huntley, of this city, president of the National Electric Light Association, has just returned from New York, where he has been making preparations for the convention.

"The electrical people down there are taking a great interest in the convention," he said, "and it is going to be a good one. The papers to be read will be of a very valuable character, not visionary, but full of good sense. It will be a business convention all through."

The convention will be held at the Library building, will begin on Tuesday, February 23, and will last four days. The Iroquois will be headquarters for the delegates.

"How many delegates do you expect?" Mr. Huntley was asked.

"Between 400 and 600. There were about 800 at the Montreal convention last Summer."

He said that among the men invited to read papers and expected to do so were Professor Weston, Newark, N. J.; Erastus Wiman, the well known financier of New York; J. B. Craven, the electric railway engineer of this city; D. Ashworth, of Pittsburgh; William Stanley, of Pittsfield, Mass.; M. C. Sullivan, of New York; E. A. Leslie, of New York; M. D. Law, of Schenectady; E. F. Peck, of Brooklyn; Richard Hammond, of Buffalo. There will also be a number of others.

"Will there be an electrical exhibit?" asked the reporter.

"That," said Mr. Huntley, "has not been determined. We have no place for such an exhibit except Music hall, and that is thought to be too far away from the place for holding the convention. Then again, the electrical supply men made a remarkably fine exhibit at Montreal last Summer, and might not care to make another one so soon."

During the progress of the convention entertainment of various kinds will be provided for the visitors. An excursion to the Falls in its Winter garb will doubtless be given, along with an opportunity to see the operations at the Niagara Falls tunnel, and a banquet may be given.

President Huntley earnestly desires that the business men of Buffalo should estimate that the coming convention is one of much more than ordinary importance, and should see to it that the visitors get well acquainted with our city and go away with a thorough appreciation of its splendid location, its beauty, rapid growth, and the wonderful possibilities of its future.

Somoff's Incandescent Lamps.

Mr. J. L. Somoff, of 1 Ann street, New York city, is out with the second part of his lamp catalogue, which contains a number of styles of fancy incandescent lamps of low voltage. The demand for such lamps, says he, is steadily growing, and the after-Christmas trade is as brisk as it was in December.

FIG. 1.

There are many wealthy residents in New York and other cities who, not satisfied with the existing, the pear lamps of 16 candle-power, have been importing fancy lamps from Germany and France. Many of them have now placed large orders with Mr. Somoff for his lamps, and much attention is

FIG. 2.

paid in selecting proper styles. We illustrate herewith some of these novel lamps.

Fig. 1 is one of the prism lamps. Mounted upon a chandelier and lit, they produce the most beautiful display of rainbow colors. The effect is incomparably superior to that of the prisms suspended from a gas chandelier.

A torch lamp (Fig. 2) is another one, also

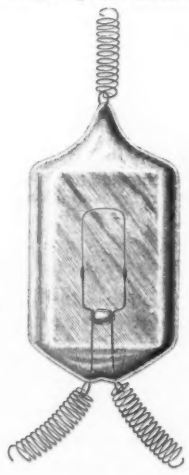


FIG. 3.

designed by Mr. Somoff, for purposes of theatrical display, etc. It has four lenses fused on to it, and all the surface around them is frosted. The effect of this combination of a true spheroidal form of the globe with frosting and lenses is to project the light in the form of four condensed beams. Last December 450 of these lamps were shipped to a theatrical company to be used in the production upon European stages of the opera *Robert le Diable*. The lamps were mounted on torches which contained small storage batteries. Little vanes at the bases of the lamps revolve with the least motion of the air and revolves the lamps, the beams of light striking in every direction.

Fig. 3 is a lantern lamp, English pattern. The storage battery lanterns as made and extensively used in England, and in large numbers imported into the United States, have a very shallow reflector and the bull's eye quite close to it. There is no room for any other but a flat lamp. The lamp is suspended from three springs, two of which constitute the terminals. This method of mounting lamps in lanterns, is as practice shows, far preferable to any other.

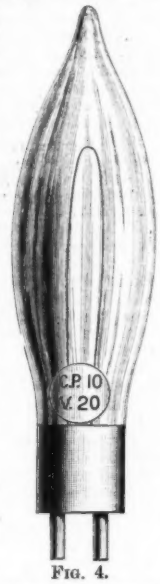


FIG. 4.

Fig. 4 is a cut of a candle lamp, the design of Mr. A. de Khotinsky, of Berlin. A large number of them is yearly imported into the United States to the orders of wealthy New Yorkers. Mr. Somoff adopted the style to supply the growing local demand, as the new protective tariff makes importation of them expensive.

Fig. 5 is a miniature candle lamp, whose globe is of corrugated and gently twisted glass.

Fig. 6 represents a corrugated sphere lamp, the corrugations of the globe producing a singular and pleasing effect of distorting the rays of light. This lamp is also made with the channels of the globe plated with silver, so that it presents a large number of alternate strips of crystal glass and mirrors, and looks then as if thousands of filaments are enclosed within the globe.

Fig. 7 is a miniature wall bracket, one-third actual size. Until the present, there were no brackets on the market suitable for miniature lamps, and it was a difficult job to fix them, especially those intended for artistic display, in a way that insures the best artistic effect. This cheap bracket is simple, neat and effective.

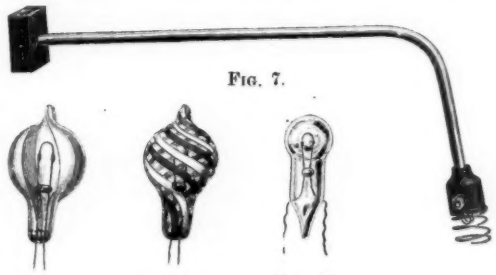


FIG. 7.

FIG. 8.

FIG. 9.

FIG. 10.

Figs. 8 and 9 are striped lamps, the stripe being alternately red, blue, milk-white and crystal. These lamps are especially suitable for flower bouquets, flower baskets and floral decorations in general. Placed in the center of a flower the lamps assume the color of

FIG. 5.

FIG. 6.

the latter, the colored stripes greatly adding to the effect.

Fig. 10 is a surgical lamp of English design. For its neat shape and effect it is rightfully called by English a "Fairy" lamp.

Fig. 11 is an antiseptic surgical lamp which, since a year ago, came into very extensive demand by physicians and hospitals, principally those for infectious diseases. It is made wholly of glass, the part surrounding the filament of crystal, and the rest, serving as handle, of opaque, milk-white glass. Any uncleanliness, that might prove infectious, can thus easily be seen and washed off with water or acids.

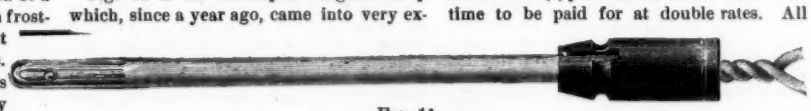


FIG. 11.

—— New Carlisle, Ind., wants electric lights.

GENERAL NOTES.

A system of riveting by electricity is now in use, and it is stated to be very successful. The alternating current is used and the upsetting done by screw pressure.

The electrical subways about the grounds of the World's Fair, at Jackson Park, will be six feet in diameter and will carry the wires for electrical power and light for the grounds and buildings.

For some time past the electric motor has been used to run the sewing machines of girls employed in glove making in their own homes, with the result that the girls do more and better work in less time and with less fatigue, while there is a marked improvement in their health.

Electro-bleaching is now carried on whereby the same solution becomes over and over again a powerful bleaching agent through the passage of the electric current through it. This bids fair to do away with a fruitful cause of the contamination of our streams by refuse bleaching powder.

The annual report of the Lancaster City and West End Passenger Railways shows that 1,249,250 passengers were carried during 1891. It is only a few years ago that horse cars were introduced in Lancaster, and financially they were not a success. The last year that the horse car lines were used 183,000 passengers were carried, and the first year of the electric system the number was 426,000. During the past year the companies paid five per cent. interest on their bonded debt and put aside a large reserve.

One of the latest applications of the electric motor is its use in the work of hoisting on the big ore docks of Cleveland, O. At that port 2,000,000 tons of ore were unloaded in 1890-91, and 1,000,000 tons of coal were shipped to the upper lake ports. In order to handle this vast quantity of material the recent steam system has been replaced by one where electricity is the motive power. The time occupied in actual work hoisting a loaded bucket of ore weighing 3,000 pounds, carrying the load 200 feet, dumping and returning, is 55 seconds. It is stated that the steam cable system takes 70 seconds.

At the last meeting of the Electrical Wiremen's Union, No. 5468, of the American Federation of Labor, which has just been organized, the following rules were adopted: On and after April 1, 1892, the wages of wiremen shall not be less than three ($3) dollars per day of nine (9) hours (except where the eight (8) hour day is already in vogue, there the same rate of wages shall apply), five days, Monday to Friday, inclusive, and eight (8) hours on Saturday. All men in charge of the work to receive not less than three dollars and fifty cents ($3.50) per day. All men eligible to foremanship shall have served four (4) years at the trade. All overtime to be paid for at double rates. All citizens or residents of this country applying for membership after the first of April, 1892, shall pay an initiation fee of twenty-five dollars ($25); payable five ($5) down, balance ten ($10) each consecutive month until paid. Foreigners will be forced to pay an initiation fee of $50, to accompany application for membership. The wages of helpers were set at $1.50 a day for the first year, $2 a day for the second year, and $2.50 a day for the third year.

ELECTRIC LIGHT NEWS

—— Caro, Mich., has decided to have electric lights.

—— Quakertown, Pa., will erect a $22,000 electric light plant.

—— Benson, Minn., is agitating the subject of electric street lights.

—— Tarentum, Pa., has voted to have electric lighting for its streets.

—— Springport, Mich., electors will vote this month upon street lighting.

—— The new silk mill at Carlisle, Pa., will put in an electric light plant.

—— The electric light system of Columbus, Ohio, will shortly be extended.

—— There is some talk of lighting the city hall at Erie, Pa., with electricity.

—— Bids for electric lighting of San Diego, Cal., will shortly be asked for.

—— Columbia, Mo., will soon have an electric light system for street lighting.

—— St. Clair, Mich., is talking of installing an electric light plant for its streets.

—— Granite Falls, Minn., has voted in favor of issuing bonds for electric lights.

—— Nevada City, Cal., will shortly be lighted by the Heisler incandescent system.

—— The village board of Madison, Ill., are discussing the subject of street lighting.

—— Warner & Wiley, of Beloit, Wis., are about to extend their electric light system.

—— Brenham, Tex., is thinking of putting in an electric light plant for street lighting.

—— The prospect of lighting the streets of Manchester, Mich., in the near future is good.

—— There is a movement on foot to light the court house and jail at Cincinnati with electricity.

—— C. E. White, superintendent of the Pottstown Heat, Light and Power Company, has resigned.

—— The Thomson-Houston Electric Company will soon furnish Lacon, Ill., with electric street lighting.

—— The stock of the Mechanicsville, N. Y., Electric Light Company, has been about two-thirds subscribed.

—— The committee on electric lighting of Lansing, Mich., are actively pushing their investigation of the subject.

—— The necessary stock for the proposed electric street lighting plant for Eldora, Ia., is being rapidly subscribed.

—— The Owensboro, Ky., Gas Company has purchased the plant and franchise of the Owensboro Electric Light Company.

—— Columbus, Ohio, has appointed a committee to prepare plans, specifications and estimates for an electric light plant for the city.

—— Denver, Colo., business men want a large appropriation for electric street lighting and have addressed a petition to the council to that effect.

—— Robert Bickerdike, of Montreal, proposes to run an electric railway from Bonaventure station (Montreal) to St. Cunegonde and St. Henri.

—— The Middletown Electric Light Company has purchased two 650 light alternating current dynamos from the Thomson-Houston Electric Company.

—— A city ordinance was recently passed at Chanute, Kan., authorizing John H. Kuder and his associates to erect and operate an electric light and power plant in that city.

—— The city council, of Mobile, Ala., will advertise for bids for the erection of an electric light plant of 200 arc lights. Also for bids for lighting the city with 180 arc lamps.

On the Law of Hysteresis.

A PAPER READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, JANUARY 19, 1892, BY CHARLES PROTEUS STEINMETZ.

In the number 137, of December 17, 1890, of the *Electrical Engineer*, I published a short article under the title "Note on the Law of Hysteresis," where I showed that in a set of determinations of the loss of energy due to hysteresis by reversals of magnetism, for different magnetizations, made by Ewing, this loss of energy due to hysteresis can fairly well be expressed by the equation: $H = \eta B^{1.6}$, where H is the energy consumed by hysteresis during one magnetic cycle, in ergs per cubic centimetre, B the magnetization in lines of magnetic force per square centimetre, and η* a numerical coefficient, in this case = .002.

Considering that even the simple law of magnetism—that is, the dependence of the magnetization B upon the magneto-motive force F (for instance, in ampere turns per centimetre length of the magnetic circuit) has until now defied all attempts of mathematical formulation, it appeared a strange feature that the apparently much more intricate phenomenon of hysteresis, or rather of the consumption of energy by hysteresis, should yield to analytical formulation in such a simple way, to be directly proportional to the 1.6 power of the magnetization. At the same time the coincidence of Ewing's tests with the curve of the 1.6 power was near enough to be considered as something more than a mere incident, but at least as a clue to a law of hysteresis, the more as this law held not only for low and medium magnetization, but even for very high saturation, without showing any kink at that point where the magnetic characteristic goes over the bend or "knee" and thereby entirely changes its shape, nor any marked tendency of deviation of the extremest observed values from the calculated curve.

In Fig. 1 and Table I, I give from the article referred to, the calculated curve of hysteretic loss, as a drawn line, with Ewing's tests marked as crosses, and in dotted line the curve of magneto-motive force F, corresponding to the different magnetizations, as abscissæ.

In the Table I:

F = the magneto-motive force in absolute units.

B = the magnetization in lines of magnetic force per square centimetre.

H_{obs} = the observed values, and

H_{calc} = the calculated values of hysteretic loss, in ergs per cubic centimetre.

$H_{calc} - H_{obs}$ = the difference between, both in ergs and in percentages.

TABLE I.

F:	B:	H: obs	H: calc	$H - H$: calc obs	$-\%$:
1.50	1,974	410	375	+ 35	+ 8.5
1.95	3,830	1160	1082	+ 58	+ 5.0
2.56	5,950	2190	2190		
3.01	7,180	2940	2956	− 16	− .5
3.76	8,790	3890	4080	− 90	− 2.3
4.96	10,590	5560	5510	+ 50	+ .9
6.62	11,480	6160	6260	−100	− 1.7
7.04	11,960	6590	6690	−100	− 1.5
26.5	13,700	8690	8310	+380	+ 4.4
75.2	15,560	10,040	10,190	−150	− 1.5
				Av: ± 98 =	± 2.6

To study more completely this phenomenon of hysteresis and of the energy consumption caused thereby, I endeavored to make a number of determinations with different magnetic circuits and at different magnetizations.

To be enabled to carry out these experiments, I am highly obliged to Mr. Rudolph Eickemeyer, of Yonkers, N. Y., who, being greatly interested in the laws of the magnetic circuit and having done considerable work himself in this branch of electrical science, not only put the large facilities of his well-known factory at my disposal, but also guided the experiments with his valuable advice. A part of the instruments used in the tests are of Mr. Eickemeyer's invention and covered by his patents.

To be able to deal not only with the small amounts of energy which the reversal of magnetism in a tiny bit of iron wire sends through the ballistic galvanometer, but to reduce the determination to readings of considerable power-values, and where a much greater exactness can be reached, and at the same time to determine the dependence of the hysteretic loss of energy upon the velocity of the magnetic cycles, I decided to use alternating currents, at least as far as this could be done, whereby the determinations of the energy consumed by hysteresis is reduced to a simultaneous wattmeter, voltmeter, ammeter and speed reading.

* If any quantity has a right to be called "magnetic resistance," it is this co-efficient η; for η is the *co-efficient of conversion of magnetic energy into heat*, while as "electric resistance" we define the *co-efficient of conversion of electric energy into heat*. The term generally denoted "magnetic resistance"—that is, the inverse value of magnetic susceptibility, does not deserve this name at all, but is more properly called "reluctance."

At the same time this electro-dynamo meter method has the advantage that the magnetic cycle is completed in a steady, continuous motion, while in the ballistic method the magnetic cycle is completed by sudden changes in the magnetization, which jumps from point to point, to enable the production of the induced current. This feature introduces an error into the ballistic method, for if a magnetic cycle is gone through by sudden changes, a larger amount of energy may be consumed than if the magnetization varies steadily in harmonic vibration.

Suppose, around a magnetic circuit, an alternating current of N periods per second is sent in n convolutions.

Let C = the effective strength of the current,

E = the effective electromotive force induced in the circuit by self-induction, after subtracting the electromotive forces induced by the self-induction of the instruments,

W = the energy consumed in the circuit, after subtracting the energy consumed by the electric resistance,

Then, l being the length and s the cross-section of the magnetic circuit, all in centimetres, amperes, volts, watts, etc.,

Let B = the maximum magnetization in lines of magnetic force per square centimetre,

H = the loss of energy by hysteresis per cycle and cubic centimetre; it is

$$W = l\,s\,N\,H \times 10^{-7}$$

hence

$$H = \frac{W}{l\,s\,N} \times 10^{-4}$$

the hysteretic loss of energy, and

$$E = \sqrt{2}\,\pi\,s\,B\,N\,n \times 10^{-8}$$

hence

$$B = \frac{E \times 10^{+8}\,*}{\sqrt{2}\,\pi\,s\,N\,n}$$

the maximum magnetism.

For higher frequencies, 80 to 200 periods per second, the alternating current was derived from a one horse-power 50 volt Westinghouse dynamo. This was driven by a three horse-power Eickemeyer continuous current motor. By varying the excitation of the motor field and varying the electromotive force supplied to the motor, the speed, and therefore the frequency, of the alternating current could be varied in wide limits. At the same time, supplied with constant electromotive force and like all the Eickemeyer motors of unusually small armature reaction, this electromotor kept almost absolutely constant speed under varying load, the more as it never ran with full load.

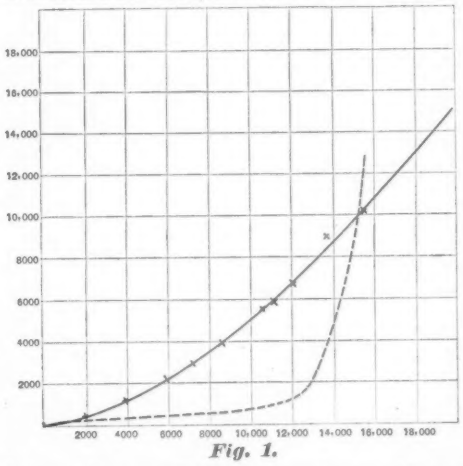


Fig. 1.

For low frequencies, this bipolar continuous current motor was used as a bipolar alternating dynamo, as shown in a patent of Mr. Stephen D. Field. On the continuous current commutator two sliding rings were mounted and connected with opposite commutator bars. In the ordinary continuous current brushes a continuous current was set in, which set the machine in motion as an electro-motor, while from the sliding rings by two separate brushes, alternating currents were taken off. By varying the electromotive force supplied to the motor, the electromotive force of the alternating current was varied, while a variation of the motor field gave the variations of the frequency. The curve of electromotive force was very nearly a sine wave, the ratio of maximum electromotive force to effective electromotive force found = 1.415; while the sine wave requires 1.414—that is, exactly the same.

* This formula holds rigidly only for the sine wave, but as shown in the following, the currents used in the tests were at least very near sine waves. Besides, a deviation from the sine shape would not alter the results at all, but only slightly change the co-efficient η.

To determine whether the change of the shape of the alternating current by varying load and varying excitation had any influence upon the readings, the variations of the alternating electromotive force were produced:

1. By varying the excitation of the field of the Westinghouse dynamo.

2. By running the Westinghouse dynamo fully excited, feeding the secondaries of a bank of converters, feeding from the fine wire coils of these converters, the fine wire coils of another bank of converters and taking current off from the secondaries of these converters, connected from one to six in series.

3. By changing the electromotive force by means of a Westinghouse converter of variable ratio of transformation.

4. By loading the dynamo when small currents were used for the tests.

But after having found that all these different ways of varying the alternating electromotive force gave no perceptible difference whatever in the readings, I afterwards used the most convenient way to vary the excitation of the dynamo field and, where higher electromotive force were needed, to increase the electromotive force by an interchangeable converter, which gave the ratio: 1 : 1, 2, 3, 4, 5.

For the determination of the frequency, a direct-reading speed indicator (horizontal ball governor, acting upon a spring) was used, which was carefully calibrated.

For the electric readings, instruments of the electro-dynamometer type were used, zero reading—that is, the movable coil was carried back by the torsion of a steel spring to zero position.

These instruments were specially built for alternating currents, with very low self-induction and low internal resistance, using bifilar German silver wire as additional resistance.

In the ammeter the range of readings was from three to 40 amperes, the internal resistance = .011 ω.

The normal inductance (that is, electromotive force of self-induction induced by one ampere alternating current, flowing through the instrument with a frequency of 100 complete periods per second): = .045 ω.

In the voltmeter the range of readings was from .5 volts upwards, but to avoid the necessity of corrections for self-induction sufficient additional resistance was used to decrease the correction under one per cent., and then the lowest readings were from three to six volts.

The internal resistance of the voltmeter is = 2.5 ω, its normal inductance = 4.12 ω.

In the wattmeter the resistance of the coarse wire coil (fixed coil) was = .026 ω, its normal inductance = .073 ω.

The internal resistance of the fine wire coil was = .25 ω, its normal inductance = .83 ω.

In most of the readings sufficient additional resistance was used to make the correction for self-induction of the fine wire coil negligible. Only in a few readings where it exceeded one per cent. it was taken in account.

For small currents an Eickemeyer ammeter was used, which, while reading from .7 to 3 amperes, though built originally for continuous currents, had already been used by me for alternating currents and had been checked for its constancy of readings several times, and always found to give no perceptible difference in its readings for continuous currents and for alternating currents up to over 200 complete periods per second, the highest frequency I could reach.

Its internal resistance is = 1.1 ω, its normal inductance = 2.03 ω.

Several sets of readings for different frequencies were taken on an old Westinghouse voltmeter converter. The fine wire coil and one of the 50 volt coils were left open. Into the other coarse wire coil an alternating current was sent, in series to ammeter and coarse wire coil of wattmeter, while the voltmeter and the fine wire coil of the wattmeter were connected in shunt around the whole circuit.

Hence a correction had to be applied for the self-induction of ammeter and coarse wire coil of the wattmeter and for the resistance of the circuit. Only in very few readings this correction amounted to somewhat more than 10 per cent. Generally it was much smaller.

The instruments were calibrated several times and their constants found to remain constant.

The speed indicator was calibrated carefully and its corrections added.

Each reading consisted of an ammeter reading, a voltmeter reading, a wattmeter reading and a speed reading.

Before and after each set of readings the zero positions of the instruments were determined, and only those sets of readings used where the zero position had remained constant.

Before and after each set of alternating current readings a continuous current was sent into the circuit and a few readings for different currents taken. Voltmeter and ammeter readings combined gave the resistance of the circuit, and both combined with the wattmeter reading gave a check for the instruments, here being watts = volts × amperes. Only those sets were used again where an entire agreement was found, and with the alternating current first readings with small currents, then with large currents, and then again with small currents taken, so that I believe every possible care was exercised to avoid any errors in the tests.

As before said, the first set of tests were made on the magnetic circuit of a small Westinghouse converter.

The constants of this converter, so far as they are of interest here, are:

Mean length of magnetic circuit, 21 cm.

Mean cross section of magnetic circuit, = 43.67 cm.²

Hence volume of iron, = 917. cm³.

Resistance of secondary coil, = .2 ω.

Further sets of readings were taken on a magnetic circuit, built up of very thin sheets of iron, alternately 8 × 1 inch and 3 × 1 inch, in rectangular shape, very carefully insulated against eddy currents with layers of thin paper between the sheets. On the two long sides two coils of each 50 turns, very coarse wire (3 No. 10 in parallel), were wound and connected in series, thereby giving $n = 100$ turns of an internal resistance of .048 ω.

Here the mean length of the magnetic circuit was $l = 41$ cm.

The cross-section, $s = 3.784$ cm.²

The circuit consisted of 58 layers of sheet iron of the thickness $s = .02577$ (calculated from the weight) and the width $w = 2.579$.

The whole volume of iron was = 155 cm.³

The sheet iron pieces were first freed from scales by dipping into dilute sulphuric acid.

In one set of tests an open magnetic circuit was used, by leaving the short end pieces (3 × 1 inch) off, and using two piles each of 66 pieces (8 × 1 inch) of the same iron, the same pieces as used in the former closed circuit tests.

In these readings, for the determination of the hysteretic loss, only voltmeter and wattmeter, but no ammeter, were used, and the susceptibility curve determined separately by voltmeter and ammeter.

The calculation of the readings was done in the following way:

After applying the corrections for self-induction of instruments, resistance and speed, the readings were reduced to lines of magnetic force per square centimeter B and consumption of energy by hysteresis per magnetic cycle H, in ergs.

Then the results were plotted on cross-section paper and if any value was found to be very much out of the curve connecting the other values, it was stricken out as evidently erroneous, not considering it worth while to determine whether it was a wrong reading of any one of the instruments or a mistake in the calculation.

Then from the other values of B and H, under the supposition that H were proportional to any power x of B: $H = \eta B^x$ this exponent x was determined.

This value x will be seen always to be so near to 1.6 that 1.6 can be considered at least as first approximation to x.

Then, under the assumption

$$x = 1.6$$

hence

$$H = \eta B^{1.6}$$

the co-efficient η was calculated, and now the equation

$$H = \eta B^{1.6}$$

plotted in a curve, as given in the figures, and the observed values of H drawn in and marked.

From the curve were taken the calculated values of H, corresponding to the observed values of B, the difference $H_{calc} - H_{obs}$ determined, and expressed in per cents. of H_{calc}.

These values are given in the tables and shown in the curves.

I. MAGNETIC CIRCUIT OF THE WESTINGHOUSE CONVERTER. FIG. 2; TABLE II.

MAGNETIC CHARACTERISTIC.

F = Magnetic-motive force in ampere turns per centimeter length of magnetic circuit.

B = Magnetization, in lines of magnetic force per square centimeter.

TABLE II. (I)

F	B	F	B	F	B
2	1500	12	14,750	45	18,150
3	3400	14	15,080	50	18,500
4	6800	16	15,370	55	18,820
5	9600	18	15,630	60	19,140
6	11,750	20	15,880	65	19,440
7	12,850	25	16,450	70	19,740
8	13,600	30	16,960	75	20,020
9	14,100	35	17,370	80	20,300
10	14,350	40	17,780	85	20,560
				90	20,820

HYSTERESIS.

B = Magnetization in lines of magnetic force per square centimeter.

H = Loss of energy by hysteresis, in ergs per cycle, and cubic centimeter, $= 10^{-7}$ watt-second.

TABLE II. (2)

Frequency: $N = 28$ complete periods per second.

B	H obs.	H^1 calc.	$H-H=$ calc. obs.	Per Ct.
3510	1178	1160	— 18	— 1.6
10,360	6286	6610	+324	+ 4.9
13,800	10,286	10,180	—106	— 1.0
17,940	15,357	15,600	+243	+ 1.6
		av:	±173 =	± 2.3

Exponent of power derived from tests: $x = 1.6111 \sim 1.6$.

Co-efficient of hysteresis: $\eta = .002410$; hence, theoretical curve $H = .00141\ B^{1.6}$.

TABLE II. (3)

Frequency: $N = 36$ complete periods per second.

B	H obs.	H calc.	$H-H=$ calc. obs.	Per Ct.
7090	3333	3500	+ 167	+ 4.8
10,250	5667	6310	+ 643	+10.2
13,410	9694	9700	+ 6	+ .1
17,080	14,417	14,400	+ 17	+ .1
19,340	16,111	17,600	+1489	+ 8 4
		av:	± 164=	± 4.4

Exponent of power derived from tests: $x = 1.6476 \sim 1.6$.

Co-efficient of hysteresis: $\eta = .002315$; hence, theoretical curve $H = .002315\ B^{1.6}$.

TABLE II. (4)

Frequency: $N = 137$ complete periods per second.

B	H obs.	H calc.	$H-H=$ calc. obs.	Per Ct.
4000	1490	1410	— 80	— 5.7
4670	1818	1800	— 18	— 1.0
5510	1358	2350	— 8	— .3
5760	2482	2520	+ 38	— 1.3
5840	2540	2580	+ 40	+ 1.6
6690	3285	3180	—105	— 3.3
6800	3358	3290	— 68	— 2.1
6860	3374	3370	— 4	— .1
12,430	8336	8610	+274	+ 3.6
13,750	10,000	10,100	+100	+ 1.0
		av:	±73 5=	± 2.0

Exponent of power, derived from tests: $x = 1.5887 \sim 1.6$. Co-efficient of hysteresis: $\eta = .002438$, hence, theoretical curve, $H = .002438\ B^{1.6}$.

TABLE II. (5)

Frequency: $N = 205$ complete periods per second.

B	H obs.	H calc.	$H-H$ calc—obs.	Per Ct.
1790	376	400	+24	+6.0
1990	463	460	— 3	— .7
2380	585	610	+35	+5.7
2620	735	720	—15	—2.1
3060	893	920	+27	+2.9
3390	1054	1100	+46	+4.2
3660	1297	1240	—57	—4.6
3710	1288	1250	—38	—3.0
4620	1822	1800	—22	—1.2
5070	2024	2070	+46	+2.2
4990	2034	2010	—24	—1.2
5910	2693	2620	—73	—2.8
6100	2844	2750	—96	—3.5
6550	3039	3080	+41	+1.3
7290	3673	3640	—33	— .9
8050	4341	4300	—41	—1.0
8320	4410	4530	+120	+2.7
8240	4561	4460	—101	—2.2
		av:	± 47=	±2.7

Exponent of power, derived from tests: $x = 1.6012 \sim 1.6$. Co-efficient of hysteresis: $\eta = .002434$, hence, theoretical curve, $H = .002434\ B^{1.6}$.

From these 4 sets of readings we get the results:

1. $N=28$ 4 readings: $x=1.6111$ $\eta=.002410$
2. 36 5 " 1.6476 .002315
3. 137 10 " 1.5887 .002438
4. 205 18 " 1.6012 .002434

Therefrom we derive the average, by giving to each value as weight the number of readings, where it is based upon:

$$x = 1.60513 \sim 1.6$$
$$\eta = .0024164$$

Hence, $H = .0024164\ B^{1.6}$.

This curve is used for calculating the values given as H_{calc}, and is plotted in Fig. 2 in drawn line.

The observed values of H are drawn in Fig. 2:

1. For $N = 28$ with the mark o
2. " 36 " " *
3. " 137 " " Y
4. " 205 " " +

The magnetic characteristic is drawn in dotted lines.

From this curve of hysteretic loss $H = .0024164\ B^{1.6}$ we derive the values:

TABLE II. (6)

B	H	B	H
1000	152	13,000	9230
2000	462	14,000	10,400
3000	884	15,600	11,610
4000	1400	16,000	12,880
5000	2000	17,000	14,180
6000	2680	18,000	15,550
7000	3430	19,000	16,970
8000	4240	20,000	18,400
9000	5130	25,000	26,290
10,000	6070	30,000	35,210
11,000	7070	35,000	45,060
12,000	8130	40,000	55,800

(To be Continued.)

A New Mining Lamp.

A German firm is bringing out a new type of electric mining lamp which differs in arrangement from the customary form, and which outwardly looks like the ordinary oil safety lamp. The accumulator is carried in a box having greater depth than length or width, and the glow lamp projects upward from the top of this, being surrounded by a glass cylinder surmounted by an iron plate, to which is attached the hook whereby the lamp is carried or suspended. The lamp weighs about 4.2 pounds, and gives a light of seven to eight candle-power for from 10 to 12 hours.—*Discovery.*

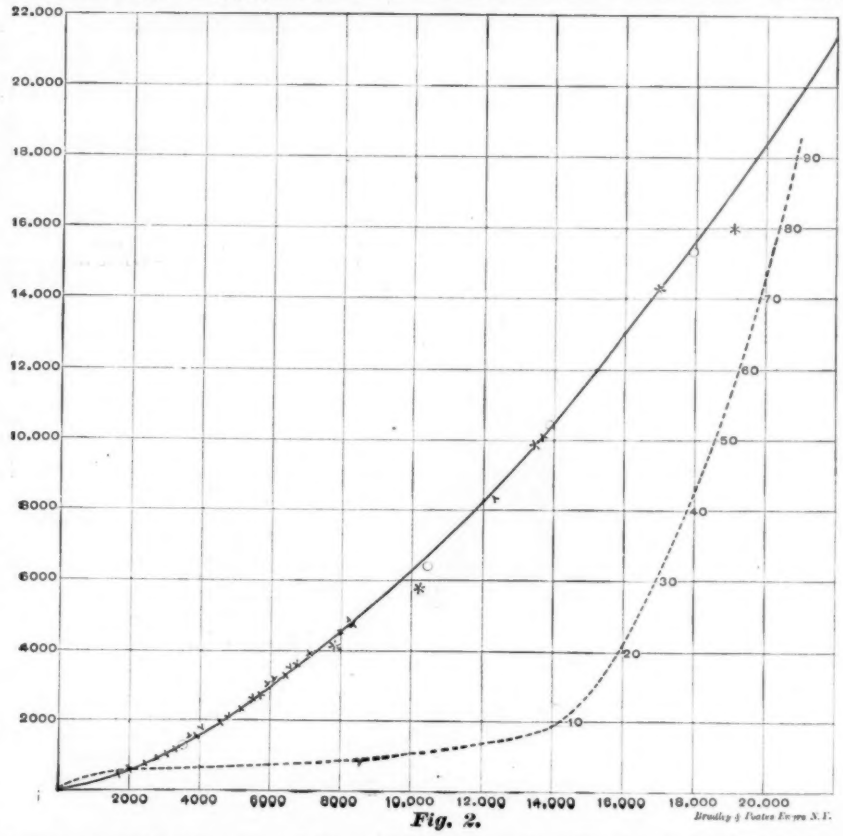


Fig. 2.

Rules Outweighed by a Life.

"It isn't often that an operator stops to think of the message he receives or sends," said an old operator. "They are all of a size to him. But I remember one time during the late war I felt my eyes moisten as I read the following to Senator Fessenden:

"'My son is sentenced to be shot to-morrow morning at 6, for sleeping at his post. Will you kindly see President Lincoln at once, and intercede till I can reach Washington to present evidence which will clearly prove my son's innocence?'

"I knew that if the message was compelled to wait its turn it would not reach Senator Fessenden till too late for any hope of reaching the President, to say nothing of getting a reprieve sent to the line of battle where the son was. I said to myself, 'Here is a human life hanging by a thread. Shall I cut the thread by letting the message take its turn?' No, I couldn't. I violated the rules and telegraphed the solemn message to all the hotels in Washington, till the Senator was found and the message safe in his hands. Word came back that Senator Fessenden had obtained the reprieve, and I telegraphed the glad news to the poor old man up in Maine."—*Detroit Free Press.*

CULLED FROM THE FOREIGN PRESS.

PROPOSED TELEPHONE LINE BETWEEN LONDON AND DUBLIN.

It is reported that the authorities at the general post office contemplate opening a telephone line between London and Dublin. The working of the Paris-London telephone has so far been attended with marked success, and it is doubtless due to this circumstance that the new line is projected. The choice of route, as well as other matters connected with the installation, are at present being considered by Mr. Preece, chief electrician at St. Martin's-le-Grand, and, so far as can be ascertained, no definite decision on these points has yet been arrived at. It is also in contemplation to lay another telephone cable between London and Paris shortly. At present the single line is fully occupied during the business hours of the day, and as the demands for its use are on the increase, the time is at hand when it will be found inadequate to the public needs. This consideration, taken in conjunction with the danger from sunken vessels, dragging anchors, etc., has determined the postal authorities to install another line.—*Electricity.*

THE ELECTRIC LIGHT IN CHURCH.

In a recent issue we commented very favorably upon the fact that an installation of electric light had been erected in a church for the blind at Liverpool. The Rev. T. W. M. Lund now writes with reference to this lighting: "Since the introduction of the electric light into our church we have had unusually large congregations in the evening, and my sermons have been of a kind to make especial demands upon my strength, which is not at its best just now. Under our old system of lighting by gas I should have been completely exhausted on Monday morning, instead of which, I now find myself tired, it is true, but far fresher than I remember to have been in all my long clerical experienced. I attribute this delightful change to the use of the electric light in place of gas, which consumed far more oxygen than the congregation itself, and helped to poison the air to boot. For the sake of the clergy, not to name the worshippers, in our numerous churches, I sincerely hope that the electric light may speedily supersede the noxious gas."—*Lightning.*

A PROTEST.

We regret that we omitted from the list of Crystal Palace exhibitors the name of the Medical Battery Company, whose wares we have over and over again alluded to in the strongest manner, because an opportunity may thereby have been lost for enabling the exhibitors as a body to vehemently protest against being associated with any such exhibit. We do not know whether the electrical trades section of the London Chamber of Commerce, the Crystal Palace authorities, or the engineer to the exhibition, are to blame in this matter, but it is not too much to say that such exhibits should have been rigorously excluded. But perhaps it is not too late, even now, to cancel whatever agreements may have been inadvertently entered into. The electrical profession has at this moment an opportunity which may never arise again of strongly protesting against electropathic belts and contrivances constructed in direct opposition to, or at variance with, the most elementary laws of electricity, and not one of which should be shown under the auspices of this important and influential exhibition.—*Electrical Review.*

ELECTRIC LIGHTING IN RESIDENCES.

The spread of electric lighting in the residential districts is largely impeded by the uncertain and short tenure of house property. During 1889 about 100 miles of mains were laid in front of the best houses, and a large number of these availed themselves immediately of the supply, but out of every 100 houses in front of which mains have been laid for a twelve-month, and which are not yet wired, 90 are likely to remain so until the termination of their present leases. Tenants are reluctant to wire their houses when a comparatively short portion of the lease remains, unless an arrangement can be made with the landlord; and, as a matter of fact, there is great difficulty in making such an arrangement. New houses are sure to be wired by the builders if the mains are at hand, and the Chelsea Company has benefited largely by the building operations on the Cadogan estate. It is difficult to see how supply companies can encourage the wiring of houses, as, although a tenant may be willing to pay for the wiring by installments, should he leave the house, the supply company have no claim whatever upon the incoming tenant, whilst under the terms of the Act he can demand a supply of current. If it could be arranged that the company could sue him for the use of the wires, this difficulty might be met; but these, unfortunately, become landlord's fixtures, and the supply companies would be driven to make the best terms they could with the landlord. The majority of landlords are content to keep their houses in a barely tenantable condition; the bursting of water-pipes is frequently treated as reasonable wear and tear, to be repaired by the tenant, and electric lighting becomes to be regarded as a mere luxury.—*Electrician.*

OVERHEAD WIRES IN LONDON.

The London county council have applied to the board of trade for their approval of by-laws regarding overhead wires in London, in pursuance of an act passed in the first session of Parliament. These rules are to apply to all wires and cables over land, other than railways or railway station property, unless they are 50 feet beyond the thoroughfares. In the first place, the owners of the wires at present in use are required to supply information as to the material and gauge of wires and supports, and as to supports, etc., and in the future similar particulars must be given 14 days before wires or cables are erected. No support or attachment is to be made in any street without authority. Wires must be more than 20 feet above ground, 35 feet above the streets and seven feet above buildings, except where brought into buildings for use, or attached to chimneys in accordance with the regulations. The supports are not to be less than 115 yards apart, unless permission in writing be got from the council, but in no case will the distance exceed 140 yards. The angle of crossing a street must not be more than 60 degrees. The supports are to be stayed for wind pressure, and are only to carry 20 wires, except with special permission. Where cables are used they are to be carried by independent suspending wires and attached by slings. The cables are not to exceed one inch outside diameter, and one pound per lineal yard in weight. The factor of safety for all conductors and suspending wires is to be at least five, for all other structures at least ten, taking the maximum wind pressure at 50 pounds per square foot. No addition, it is added, need be made for the accommodation of snow. All iron or steel material is to be galvanized, and the supports if of metal, are either to have conductors to earth or otherwise to have lightning conductors. Many other details are incorporated in the by-laws; but they need not be specified. They indicate that the county council are determined to know all about the wires, and to have them erected to their satisfaction. The penalty for any infringement is to be £10, and 40 shillings per day is to be paid for continuance of the offense after the judgment of the court. Of course, where wires are in private property, and are not likely to interfere with the public thoroughfares, the laws are not applicable.—*Engineering.*

KINDRED INTERESTS

The Jos. Dixon Crucible Company, Jersey City, N. J., issue a neat little folder describing their well-known lead pencils. Any one can be suited in their wide range of pencils.

John Becker, Boston, Mass., who is building works at Fitchburg, Mass., has purchased a 35 horse-power engine from the Ball Engine Company, Erie, Pa., for his electric light plant.

Curtis & Curtis, of Bridgeport, Conn., manufacturers of the Forbes patent die stock, pipe cutting and threading machinery, etc., have just shipped to the Pacific coast, on one order, 14 of their pipe cutting and threading machines.

W. A. Giles, 416 Lewis Block, Pittsburgh, Pa., has secured the agency for his territory of the following apparatus: McIntosh & Seymour engines, Porter engines, Goubert feed water heaters, Stratton separators, Case engines and Wing's disk fans.

Alfred F. Moore, 200 North Third street, Philadelphia, the well known wire manufacturer, has withdrawn, until further notice, his agency in Chicago, lately controlled by Mr. G. A. Harmount. All communications and orders should be sent direct to the Philadelphia office.

The Americal Electrical Works, of Providence, R. I., have just issued a souvenir of the Montreal meeting of the National Electric Light Association in the shape of photographic group of a number of the prominent persons in attendance, taken in the Victoria Skating Rink. It is an excellent idea and the card will be prized by its recipients.

Queen & Company.—Some time since this enterprising firm placed on the market a new type of electro dynamometer which, we learn, has met with great favor. By the adoption of an agate bearing instead of fibre suspension, as formerly used, the element of torsion is eliminated and greater accuracy obtained in consequence. These instruments are extensively employed as absolute standards in measuring both direct and alternating currents, and are especially suited for use in central stations as checks for the ordinary commercial ammeters.

The Ries Electric Specialty Company, of Baltimore, Md., were awarded the first premium and medal at the electrical exposition, recently held at Augusta, Ga., for their well-known regulating socket for alternating current incandescent lamps. This company is deserving of this honor, as their regulating socket will do more toward making incandescent lighting universally popular than any invention ever yet produced. The Ries regulating socket is being generally adopted throughout this country and abroad, and on all sides we hear only good words for this company's regulating sockets.

NOTICE.

Parties desiring to attend the National Electric Light Association Convention, to be held at Buffalo, New York, February 23-25, 1892, will find it to their interest to note the special inducements offered by the Michigan Central Railroad for transportation over their road, which will appear in the subsequent issues of the REVIEW.

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Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 72 in. x 60 in. x 25 ft.; 72 in. x 60 in. x 20 ft.

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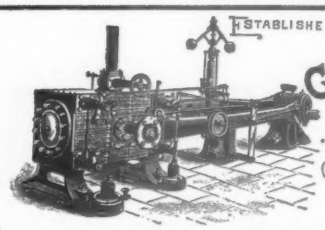

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON JANUARY 12, 1892.

467,023 Lightning arrester; George W. Spittle, Compos, Brazil.

467,048 Electric motor; John H. Palmer, Boston, Mass., assignor of one-half to Richard Smith, Sherbrooke, Canada.

467,050 Electrically controlled car switch; Burt I. Potter, Boston, Mass.

467,075 Electrical heating apparatus; Arthur E. Appleyard, Boston, assignor to H. L. Millis, trustee, Millis, Mass.

467,078 Rheostat; Francis O. Blackwell, Boston, Mass., assignor to the Thomson-Houston Electric Co. of Connecticut.

467,085 Electric insulator for boilers; Peter Decker, Norwalk, Conn.

467,102 Nautical signal or sea telephone; Ernst Huber and Frederick J. Kneuper, New York, N. Y., assignors of one-third to James R. Davies, same place.

JANUARY 19, 1892.

467,160 Holder for telephone receivers; Richard Dent, Grand Rapids, Mich.

467,169 Filament for incandescent electric lamps; Philip Hickley, Evanston, assignor, by mesne assignments, to Robert D. Sheppard, Cook County, Ill.

467,192 Electric elevator; Norton P. Otis and Rudolph C. Smith, Yonkers, N. Y., assignors, by mesne assignments, to the National Co., Chicago, Ill.

467,199 Electric arc lamp; Joseph Riedel, New York, N. Y.

467,215 Commutator; Henry P. White, Kalamazoo, Mich.

467,230 Method of and apparatus for controlling electric motors and generators; Cary T. Hutchinson, New York, N. Y., assignor to the Edison General Electric Co., same place.

467,233 Process of electric metal working; Hermann Lemp, Lynn, and Walter S. Moody, Chelsea, Mass., assignors to the Thomson Electric Welding Co. of Maine.

467,239 467,240 Battery zinc; Charles B. Schoenmehl, Waterbury, Conn.

467,243 Electro-magnetic brake; Henry E. Walter, London, England.

467,250 Trolley for electric railways; Edwin R. Harding, Winthrop, Mass.

467,255 Liquid rheostat; Hermann Lemp, Lynn, Mass., assignor to the Schuyler Electric Co. of Middletown, Conn.

467,259 Electric railway brake; Edmund Verstraete, St. Louis, Mo., assignor of one-half to Peter M. Kling, same place.

467,270 Incandescent electric lamp; Charles H. Wilkins, Chicago, Ill.

467,276 Incandescent electric lamp; John L. Curtiss, Grand Rapids, Mich.

467,287 Automatic cut-off for gas burners; Jas. E. Hogan, Oakland, Cal.

467,297 Mechanism for controlling the application of power; Jas. F. McLaughlin, Philadelphia, Pa.

467,318 Commutator for dynamo-electric machines and motors; Elihu Thomson, Swampscott, Mass.

467,338 Rheostat; Charles Wilbus, Baltimore, Md.

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